Bulletin No. 46 1915

Agricultural Research Institute, Pusa

BEE-KEEPING

BY

C. C. GHOSH, B.A.,
Assistant to the Imperial Entomologist

CALCUTTA
SUPERINTENDENT GOVERNMENT PRINTING, INDIA
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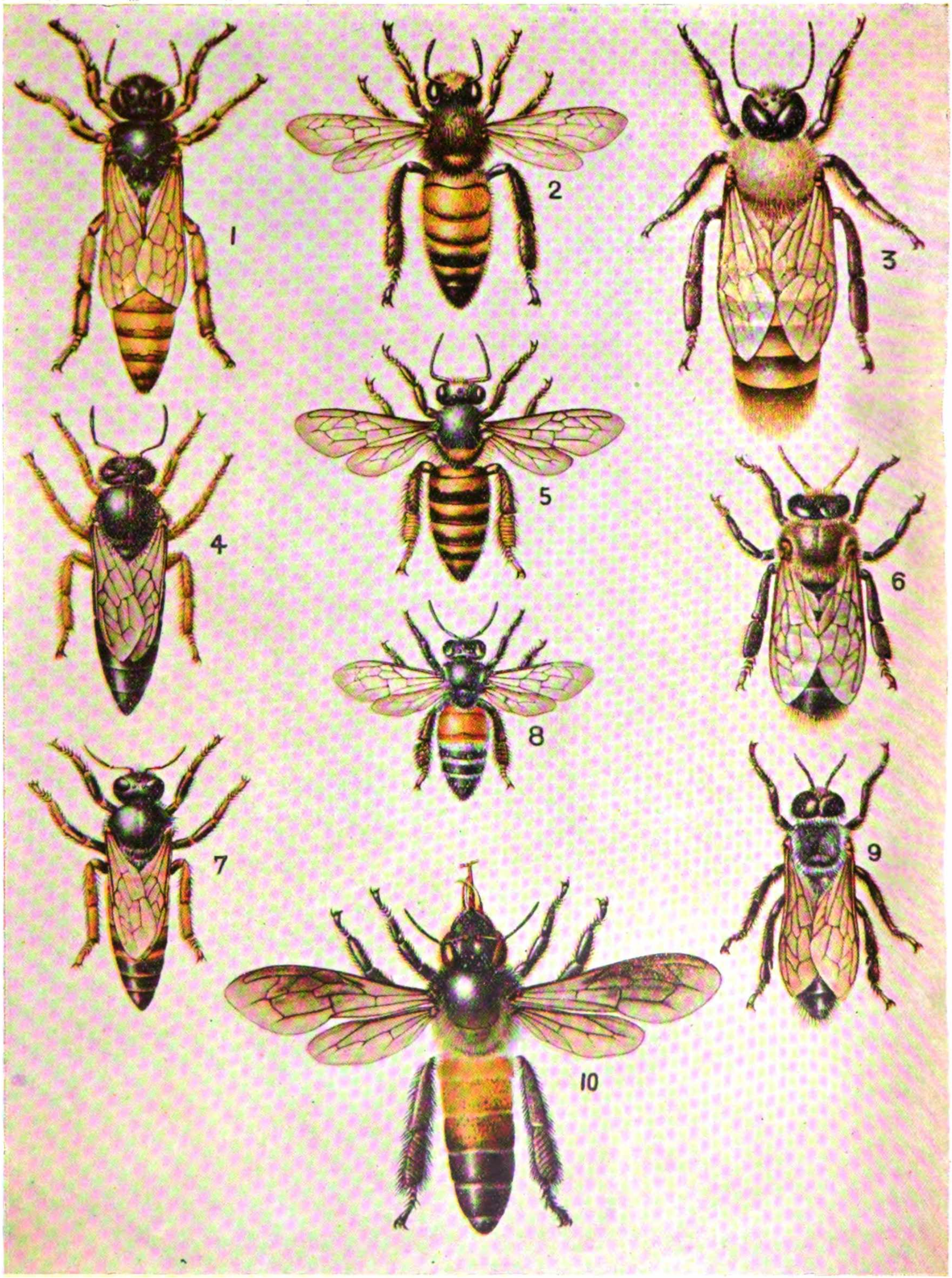
PLATE I.



HONEY BEES.

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EXPLANATION OF PLATE I.

Honey Bees.

Fig. 1.—Queen of the Italian Variety of the European Bee (*Apis mellifica*).
" 2.—Worker ditto ditto ditto.
" 3.—Drone ditto ditto ditto.
" 4.—Queen of the Indian Bee (*Apis indica*).
" 5.—Worker ditto ditto.
" 6.—Drone ditto ditto.
" 7.—Queen of the Little Bee (*Apis florea*).
" 8.—Worker ditto ditto.
" 9.—Drone ditto ditto.
" 10.—Worker of the Rock Bee (*Apis dorsata*).

All the figures are magnified about two-and-a-half times.

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PREFACE.

WE have in India three important classes of insects which yield products useful to man. They are Silkworms, Lac-insects and Honey-bees. Practical directions for the cultivation of both Eri and Mulberry Silkworms and of Lac have already appeared in this series (*Pusa Bulletins* Nos. 29, 39 and 28). The present Bulletin provides similar information regarding Honey-bees and Bee-keeping in India.

Thirty-five years ago Government inquired into the question of Bee-keeping in India and published the replies from Local Governments under the title of " A Collection of papers on Bee-keeping in India " (Calcutta ; 1883). A few years later Mr. J. Douglas brought out a small Handbook of Bee-keeping in India (Calcutta; 1884) ; this is now long since out of print and unobtainable. After this the subject seems to have languished for many years, although bees were kept in frame hives by a few people in some of the Hill Stations. In 1907-08 a few colonies were brought to Pusa from Simla but these were not successful and soon died out. In 1910 and again in 1911 we imported European Bees and tried these at Pusa and in the latter year I published notes on Bee-keeping and on Wax-moth in the *Agricultural Journal of India*, Vol. VI, Part IV, and projected a further series of articles and a practical manual on the subject. My transfer to Madras and pressure of other more urgent work has delayed this and this Bulletin has been prepared for present use by Mr. C. C. Ghosh, who has acquired some knowledge of bee-keeping mainly under my direction. It is frankly to a large extent a compilation from various excellent manuals on the subject prepared in Europe and America but these of course do not deal with Indian bees or Indian conditions, nor are these books readily accessible in India ; so that it has been necessary to add some account of Indian bees and of the modified form of Standard Frame-hive which has been found practically useful with *Apis indica,* the only Indian wild bee which it seems possible to domesticate in any way.

It is hoped that this Bulletin may be useful to bee-keepers and would-be bee-keepers. There is a large scope for bee-keeping in India, especially in the Hills. The native Indian bee is common, easily obtainable almost everywhere and easily kept in frame-hives, except that it often shows a tendency to desert the hive after a few months; a drawback is its small yield of honey, which only averages about five or six pounds per hive yearly. In orchards and similar places, where bees are required to pollinate flowers it should, however, be well worth while to keep these bees for this end alone.

Bee-keeping cannot be looked on as a source of income in India except perhaps in a few exceptional localities and even then only in cases where the bee-keeper is a practical expert willing and able to take the necessary trouble to attain results; bee-keeping is not a short cut to fortune anywhere, probably less so in India than in most other countries. It is necessary to say this because we frequently receive inquiries from correspondents who suppose that they have nothing to do but get a few bees and leave them to produce honey and wax which their owner has only to collect and sell without any trouble or expense. We can only recommend beginners to start on a small scale, at first with two or three hives at the most, and to add to these only as they gain experience.

T. BAINBRIGGE FLETCHER,
Imperial Entomologist.

PUSA;
16th July 1914.

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BEE-KEEPING.

Introductory.

Honey is so much prized that the idea of being able to keep bees and make them produce honey for the use of their owner possesses a charm in itself. Bees being very common in India, honey is obtained simply for the labour of gathering it. Therefore many think that bee-keeping is very simple work. It is simple enough if by it is meant giving shelter to the bees—because bees come and build combs wherever they get suitable shelters—and taking the honey when it is gathered. Bee-keeping as practised in India all over the Hills, is of this description. The writer has come across hill bee-keepers, some of them four-score years or more old and keeping bees from their boyhood, who do not know even the elementary things about bee life and describe the queen-bee as the *King* simply directing the colony by *his* orders and not doing anything else, and the worker bees as females who amongst other work produce young bees only once in the year. It is therefore no wonder that, though bees have been known to exist in India from time immemorial, bee-keeping has made little progress and has remained in the same condition for ages. Enormous quantities of honey are produced but as no one knows how to take out the honey from the bees' combs in a pure state, it ferments soon after being gathered and is reduced to the condition of thin jaggery or molasses. Sometimes it is worse than molasses on account of its possessing a bad odour due to fermentation. This honey is stocked for sale by grocers all over India, because there is a demand for honey for medicinial and other purposes. While holding the belief that this thin syrup sold as honey is adulterated, all purchase it because better honey is not available. As a matter of fact this honey may be pure in the sense that it has been gathered from honey bees and has not been mixed with any foreign stuff. But fermentation has produced the change and has altered the properties altogether so that it can no longer be considered as honey. This is due to its being gathered in a crude manner so that fermentation sets in within a month or two of its being gathered. Therefore it sells at a very low price in the honey season, at the rate of up to 8 lbs. per rupee or more. People purchase and eat it. Imported honey, being gathered in a proper manner, keeps for years and is sold at a rupee a pound. It must be noted here that it is not always safe to accept all imported honey as pure. Adulteration has been carried so far that even in countries like America where bee-keeping has made vast improvements, samples offered for sale as pure honey do not contain even a drop of natural honey in some cases. The honey that has been produced at Pusa according to modern scientific methods has been adjudged by dealers at Calcutta no way inferior but rather superior to the imported honey. This honey has been kept for years. If gathered in a proper manner there is no reason why the vast quantity of honey that is annually obtained from bees in India, should not similarly keep. It can then fetch a much higher price. The honey gathered in the Hills does not go bad so quickly and may not go bad for a considerable length of time, on account of the cold which retards fermentation. Hence the Hill honey sells at a very high price, its average rate being about 8 to 10 annas a pound. In the Darjiling Jail the honey sells at a rupee a pound, although it too ferments after some time when brought down to the Plains. Pure honey is a rarity in India although honey is so common. For a pure stuff people are willing to pay a price of 8 as. a pound wherever offered. They consider this price very cheap. As a matter of fact even if offered at as. 12 or more for a pound, the demand will be found more than it will be possible to meet for some time. The market is ready but the produce itself is wanting.

What is needed at present is the introduction of improved methods of keeping bees and a spread of the knowledge of proper methods of taking out the honey from the combs and of taking proper care of the honey. This will vastly improve the present conditions. Introduction of improved methods of bee-keeping will increase the production of honey. As a concrete instance of what improved methods will do, the case of the United States of America may be cited. The old methods practised there were about the same as those followed in India. In 1850 the production of honey and wax there was together about 14,800,000 lbs. The improved methods were introduced about 1853 and the production of honey alone in 1860 was about 23,100,000 lbs., the wax produced in the same year being about 1,330,000 lbs. In 1900 the produce of honey was about 61,200,000 lbs. and wax about 1,800,000 lbs. In India such results cannot be expected because the bees here are inferior in many respects to those of America. But still it is certain that adoption of improved methods will increase the production at least twofold, and with a good gathering bee the produce may be twenty times of what it is at present. Proper methods of extracting the honey and a proper care of it will save it from going bad. It can then be sold for its proper price and a vast amount of money that is now wasted will be saved.

Bee-keeping is best commenced with bees which are available locally because the beginner is sure to make mistakes and cannot afford to make experiments at the risk of loss. Therefore all intending bee-keepers should commence with the indigenous bees and with cheap hives made out of ordinary kerosene packing cases which are available everywhere in India. The beginner will have a small return in the shape of honey and in addition that acquaintance with bees which is essentially necessary to successful bee-keeping. He can then confidently invest money in purchasing improved races of bees without the risk of loss.

In this Bulletin an attempt has been made to acquaint the reader with the principal features of the life of the honey bee, also with the indigenous bees and the prevalent methods of keeping them. An endeavour has been made to make the aspects of bee-keeping in India clear. Detailed instructions have been given, with illustrations wherever necessary, as to the up-to-date methods of keeping and managing bees, together with plans and figures of hives and all other necessary appliances. The appliances recommended are of such a nature that with the exception of a few they will suit both the indigenous and the European bees with slight modifications in use.

It is essential for the spread of modern bee-keeping that hives, frames, etc., which are used in it, should be of a standard size and all bee-keepers should adopt this standard. The advantages are obvious, when the parts are interchangeable. If properly carried on, bee-keeping is sure to spread and as in Western Countries individual bee-keepers are sure to arise who will own several dozen or perhaps even several hundred colonies. It is essential for individual bee-keepers to use materials of the same size in all hives because it is frequently necessary to take frames of combs from one hive and put them in other hives. Similarly standardization is essential for co-operation among all bee-keepers. In India a beginning has to be made in modern methods of apiculture and every hive that is used has to be made. It will therefore be easy to introduce any standard. It seems advisable to adopt the standard followed by the British Bee-keepers' Association. The materials are as simple as may be under the circumstances, and as there is a large demand for them most of them are turned out by machinery and are therefore supplied cheap. Adoption of any new standard will hinder the progress of apiculture as there may be difficulties about their manufacture and supply. Further, if it is desired to import European bees, it will be still more advisable to adopt the European standard so that keepers of the Indian bee can also keep the European bee without any additional expenditure in materials. The British Bee-keepers' Association materials are made to suit the European bees but have been found to be suitable for the Indian bee with slight modifications in use which have been noted where

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Further, the aim has been adaptation to prevalent Indian conditions rather than costly innovations. In many places bees are found in empty kerosene boxes and recesses in walls. Instead of discarding these kerosene boxes and wall hives, they should be converted into modern hives. Full directions are given as to how they can be thus converted.

The Bee.

The bee is a common insect, familiar to all. If we catch one and examine its body and limbs we find what is diagrammatically shown in Figure 1. The whole body is marked out into three distinct parts by means of intermediate constrictions *viz.*, head, thorax and abdomen. The head bears (1) a pair of big eyes, one on each side, (2) three small shiny eyes on the upper surface, called ocelli or simple eyes, (3) a pair of feelers called antennæ (singular, antenna), (4) a pair of jaws which can be used for cutting hard substances, (5) a tongue covered by the sheaths. By means of the tongue the bee sucks nectar from flowers. The thorax bears two pairs of wings,—one pair on each side—and three pairs of legs. The bee can both fly and walk. The abdomen bears at the hind end the sting whose acquaintance almost all have occasion to make. The bee, however, is not born as we see it. The mother bee gives birth to an egg and after the egg-stage two distinct and altogether different-looking stages have to be passed through before the bee appears as we see it.

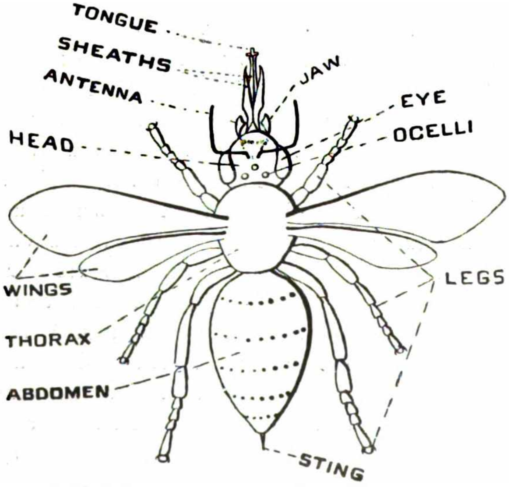

Fig. 1.—Diagrammatic illustration of a bee.

Development of the Bee.

The transformations of the bee are illustrated in Figure 2. The mother bee lays the egg (Figure 2*a*) which is a short delicate white tubular structure and slightly curved on one side. From this egg a tiny white legless wormlike grub hatches (Figure 3B). The grub feeds and grows in size (Figure 2*b*) and when fullgrown and fullfed, transforms into pupa (Figure 2*c*). The pupa is similar in appearance to the bee having developed legs, mouth-parts and all the appendages of the body. But these appendages are folded on the body and are not capable of being used. The pupa is the resting or sleeping stage and from it the active busy bee is born. The adult bee is capable of taking care of itself but in the three earlier stages of development, *i.e.*, in the egg, grub and pupa stages, it is helpless and has to remain in the comb under the care of the adult bees.

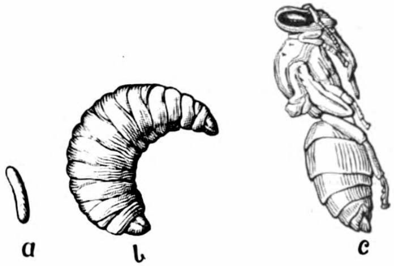

Fig. 2.—Development of the bee.
(*a*) Egg ; (*b*) Grub ; (*c*) Pupa. (All are magnified.)

Figure 3 illustrates how these stages are passed in the comb. The honey comb, as every one knows, is a double series of horizontal well-like chambers attached back to back and opening in opposite directions. Each chamber is called a cell and it is hexagonal in shape. The egg is deposited by the mother bee at the bottom of the cell, one in each, as shown in Figure 3A. The egg stands on one end. The young grub is shown at Figure 3B. It lies at the bottom of the cell in a curved posture and is provided with food by the adult bees which are therefore called nurse-bees or nurses. In the first three days of the life of the grub the food provided is a very rich nitrogenous liquid substance called " Bee-milk," believed to be secreted by the nurse-bees from some glands in their head. After this period, the food given is a sort of a paste, called " bee-bread " prepared by the nurse-bees with pollen principally, and a little honey and water. A large quantity of food is not given at a time but only so much as is required by the grub. The nurse-bees therefore have to watch the grubs constantly and this they do unceasingly. Figure 3C shows how the grub remains coiled in the cell when it is grown and ultimately stretches itself and occupies the cell lengthwise as shown in Figure 3D. When it is full grown it does not require any more food and the nurse-bees close the mouth of the cell in order to provide it with a snug closed chamber in which it may pass the resting pupal stage undisturbed. As a further protection the grub itself lines the closed cell

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with a very thin layer of silk exuded from its mouth. When it has spun this silken covering the grub rests for a short time before transforming into a pupa with its head turned towards the now closed mouth of the cell. The pupa is shown at E, Figure 3. When the bee is born from the pupa, it bites away the cover of the cell, comes out and takes its place among the adults. In a bee-colony several thousand grubs are thus reared at a time and are spoken of as "brood." While the grubs are being fed they are called "unsealed" or "uncapped" brood and when their cells are closed they are called "capped" or "sealed brood." The unsealed brood requires constant attention from the nurse-bees, but all, eggs as well as both sealed and unsealed brood, have to be under the care of the adult bees for warmth. The adult bees sit upon the combs covering them and thus keeping them warm. Without this warmth the eggs do not hatch and the brood, whether sealed or unsealed, dies. Therefore it is clear that the bees in a colony will rear only as much brood as they can care for and keep warm. A populous colony rears more brood than a weaker one. Also the same colony rears more brood when the bees get and gather nectar and pollen from plants than when these substances become scarce.

It must be remembered that actual growth takes place in the grub stage when food is taken. The egg and pupa are dormant stages. The adult bee feeds in order to live but does not grow at all.

The Bee Colony.

Honey bees are social insects and live in large colonies (Figures 4 and 5). Wherever they live they build the well-known honey-comb. The chambers or cells of the comb are utilized for rearing the brood and as store-houses for honey and pollen. All the adult bees forming the colony sit in a cluster on and covering the combs and they have not got and do not require any enclosed chambers for themselves. The members making up the colony are, the mother bee or as she is called the "queen," a large number of working bees called "workers," and some male bees called "drones." Drones may or may not be present throughout the year. The queen, workers and drones undergo the same transformations in their development but are different in appearance and size. In Plate 1, figures 1, 2 and 3, show respectively the queen, the worker and the drone of the Italian (European) Bee (*Apis mellifica*), figures 4, 5 and 6 those of the Indian Bee (*Apis indica*) and figures 7, 8 and 9 those of the Little Bee (*Apis florea*). All the figures are drawn to the same scale and magnified about 2½ times the natural size. The comparative sizes of the three different varieties of bees as well as those of the queen, worker and drone

PLATE II.

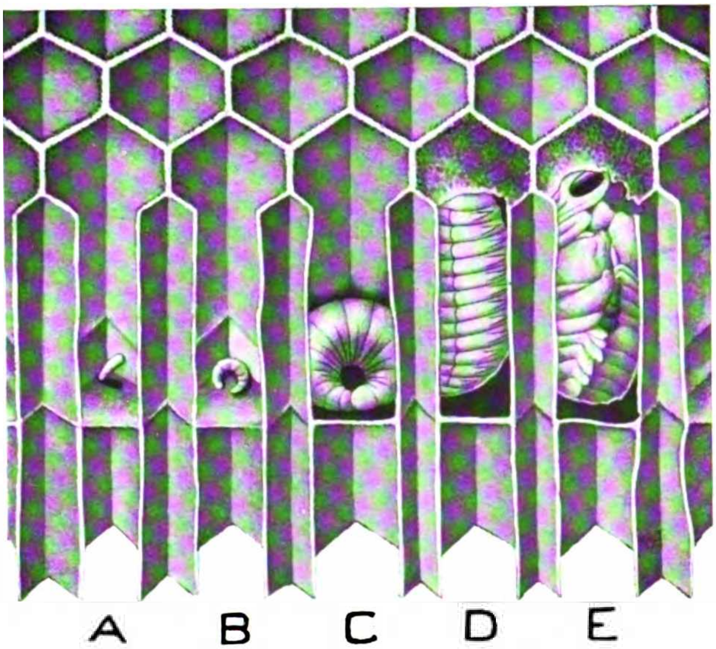

Fig. 3.—Development of the bee in the comb.

A. Egg as naturally laid at the bottom of the cell.

B. Young grub as it remains at the bottom of the cell after hatching from the egg.

C. Grown up grub as it remains coiled in the cell.

D. Full-grown grub ready to pupate in the capped cell.

E. Pupa in the cell.

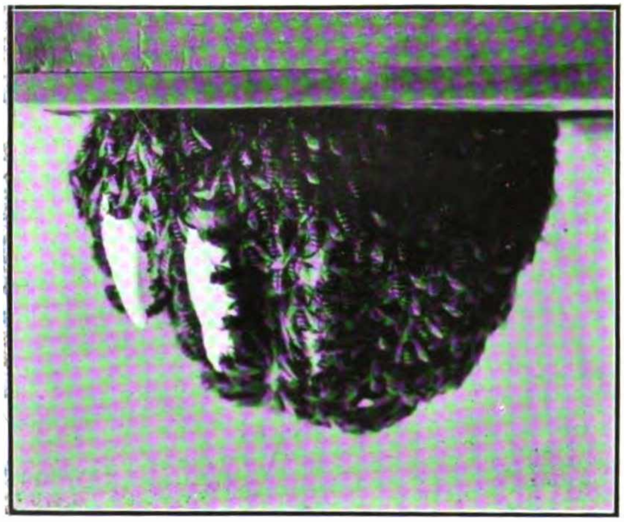

Fig. 4.—A Colony of the Indian Bee (*Apis indica*).

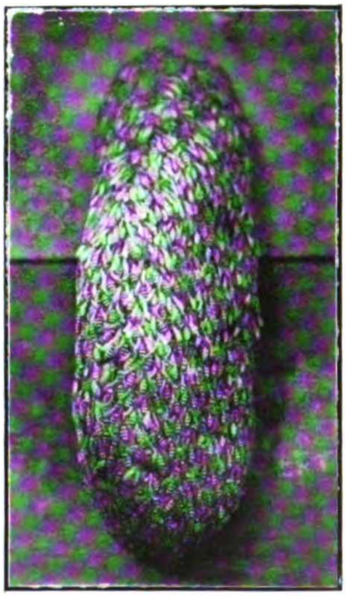

Fig. 5.—A Colony of the Little Bee (*Apis florea*).

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are evident. There is a distinct differentiation of the work to be done by these different members and in order to fit them for their respective work some modifications are observed in their development.

The Queen.

In a colony there is, as a rule, only one queen. She is the mother of all the workers and drones found in the colony as well as of any queen that may be born in the colony. Her only function is to lay eggs. There is no special "royal" chamber or seat for her. She, like all the other members of the colony, sits on the combs and walks over all the parts of all the combs, and goes about depositing eggs in the cells. She thrusts her head into each cell to see if it is empty and then moves forward, thrusts the hind end of her body into it and deposits a single egg at the bottom of the cell. Her part of the work is done when she has deposited the egg, which as well as the subsequent grub and pupa are taken care of by the workers. She lays several hundred eggs every day and is capable of laying and does lay up to two thousand or more eggs daily in the height of the season. She lives for about three years. New queens are produced only when it becomes necessary to replace the reigning one. As the queen is the most important member of the colony, being the mother of all, particular care is taken of her from the beginning. The grub which will ultimately develop into a queen is fed in a specially built elongated big chamber, called a queen-cell (Figure 6), in order to provide it with a large space

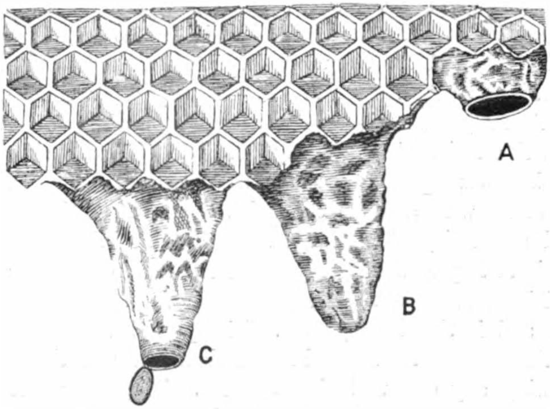

Fig. 6.—Queen cells as they are naturally built at the margin of the comb.
A. Queen-cell commenced. B. Queen-cell capped.
C. Queen-cell from which the queen has emerged.

so that its growth may take place unimpeded. When it is intended to rear a queen, such a cell is built (Figure 6A) and the reigning queen is persuaded to lay an egg in it. The egg hatches after three days. The grub is provided with a profusion of the rich nitrogenous bee-milk which, as it forms the only food of the queen grub, is also called "royal jelly." It becomes fullgrown in about 5½ days and then the queen-cell is capped as in Figure 6B. The grub transforms into a pupa and attains the adult stage in about 7 days more and comes out by opening the apical part of the queen-cell like a hinged lid as shown at Figure 6C. After this the queen-cell is demolished by the bees.

When the queen is about five days old she goes out of the hive in the middle of the day and flies out into the open air in order to meet a drone. She may be surrounded by hundreds of drones in the hive but never mates inside the hive. Probably this is the provision in nature to prevent inbreeding. The drones too fly in the middle of the day and when the virgin queen comes out of the hive and flies, they are attracted to her probably by a particular smell she emits. She mates with one drone who may overtake her in her flight. The drone dies soon after mating has taken place and the queen returns to the hive and then begins to lay eggs and does not usually leave the hive afterwards. The queen may not succeed in meeting with a drone on the first day and in that case will go out every day until she finds one. She will thus go out only until she is about three weeks old, after which she does not go out even though she has not succeeded in mating; she is then destined to remain a virgin.

Whether the queen has succeeded in finding a mate or not is a matter of vital concern to the hive. If she has been fertilized by a drone she will be able to give birth to queens, workers and drones. But if she has not been fertilized, she gives birth to drones only and this phenomenon is known as Agamogenesis, *i.e.,* production of offspring without coming in contact with a male. The properly fecundated queen is able to produce all kinds of bees, *viz.,* queens, workers, and drones for the following reason. When she mates with a drone the male sperm or seminal fluid is collected in a special receptacle, which has an opening into the passage through which eggs have to pass when being deposited and each egg, as it passes out to be laid, receives a minute portion of the seminal fluid from the seminal sac and is thus impregnated. The queen has the power of closing or opening the outlet of the seminal receptacle at will and thus of allowing or not allowing any egg to be impregnated. Therefore a fertilized queen has the power of laying two kinds of eggs, impregnated or unimpregnated. From unimpregnated eggs drones are born and from impregnated ones queens and workers are born. The difference between a queen and a worker is only one of degree of development. Both are of the female sex; the queen is a fully developed female having all her parts and organs fully developed; the worker is an undeveloped female, her organs not developing on account of the stinted nature of the food given to her while she is in the grub stage. Therefore we see that the fertilized queen lays male eggs from which drones or male bees are born and female eggs from which female bees, *viz.*, workers or queens are born. The sex of the egg is determined, before it is laid, by impregnation or otherwise with the seminal fluid. Therefore it is clear that when the contents of the seminal sac are exhausted, the queen will lay only unimpregnated eggs from which drones only will be born. This is what actually happens. When the queen is old she produces many drones, as all the eggs are not impregnated on account of the lessening of the fertilizing fluid, and ultimately produces nothing but drones when the fluid is entirely used up. Also when she is not properly fertilized, she breeds both workers and drones in the beginning as long as the seminal fluid lasts and then begins to breed drones only even in the prime of her life.

The Worker.

As will appear from the figures in Plate 1, the worker-bee is smaller in size than the queen or the drone, but more agile and active than either. The workers form the main population of the colony and in a fairly strong colony ought to number not less than 20,000 and in a good strong one there may be forty, fifty or sixty thousand or even more workers.

The worker bees are reared in the ordinary cells of the comb, Figure No. 3 showing the various stages of development. The ordinary cells of the honey-comb are for this reason called "worker cells." As already explained the queen lays one impregnated egg in each cell. The egg hatches after three days and the grub is fed by the nurse-bees for about six days. For the first three days the food given to it is the same royal jelly as given to a queen grub and then it is bee-bread. We have seen that the queen-grub is fed with royal jelly all along. This difference of food brings about the difference between a queen and a worker-bee. The rich royal jelly enables the queen to attain full development and she becomes a perfect female. The less nutritious bee-bread does not enable the worker to be fully developed and she remains an imperfectly developed female. After six days of feeding the cell is capped and the grub pupates inside and comes out as the adult worker-bee in eleven days more.

As their name implies, it is the worker-bees which do every kind of work that has to be done in a colony.

(1) They build comb. Combs are built with wax and not with pollen as supposed by many. This wax the workers secret efrom their own body through certain parts situated on their lower surface and then build the comb by moulding the wax with their mouths.

(2) They rear the brood, *i.e.*, take care in the developmental stages of all the bees which are born in the colony. They secrete royal jelly from the glands in their head and prepare bee-bread and distribute these foods to the grubs.

(3) They keep up the warmth of the hive.

(4) When the hive becomes heated they fan out the hot air with their wings.

(5) They guard the colony against enemies.

(6) They take care of the store, *i.e.*, honey. When the honey is freshly gathered from flowers it contains a good deal of moisture. The warmth of the hive evaporates this moisture and when it has been evaporated to a point which just keeps the honey in the fluid state, the honey is said to be ripe and then the bees close the cells containing honey with a layer of wax. It is then spoken of as " sealed " or " capped " honey.

(7) They keep the hive clean, carefully throwing out dirt and debris and dead bees.

(8) They take care of the queen, attending on her in her perambulation over the combs and feeding her with royal jelly in order to keep up her strength and vigour in her exhausting work of depositing thousands of eggs.

(9) They gather honey, pollen and water for the use of the colony as food and a dark-coloured gum called bee-glue or propolis with which they stop cracks and crevices in the hive. Honey is the principal food of the adult bees and pollen that of the developing grubs. The honey and pollen gathered by the bees is spoken of as " bee-forage ."

Items (1) to (8) constitute work in the hive and (9) that outside the hive. Here too we find a differentiation of work though not hard and fast, the older workers doing the outside work being styled " foragers " and the younger workers doing the work inside the hive, being styled " nurse-bees " or " nurses." This differentiation becomes rather necessary, as those workers which are about two weeks or so old are not capable of secreting, at least so well and in as large quantities as young workers, the royal jelly so essentially necessary for rearing brood. The young workers work as nurses for about two weeks after which they begin to work as foragers, but may begin earlier when there is press of work. Similarly foragers too can do, if necessary, at least a part of the work inside the hive.

The above constitute the routine work of the hive. As will appear later on the workers do other work of a very high order of intelligence or instinct or whatever we may call it, at the time of replacing an old or dead queen or swarming.

It may be asked how long the workers live when they have so much work to do. In busy seasons when an excessive amount of brood-rearing and foraging has to be done, they do not live for more than five to six weeks. As will appear later on, the greater part of the year is not a busy season for the bees, and at this time the workers live for about three months. In countries with severe winters the bees hibernate in the cold weather, no brood-rearing or foraging being done. The workers live through the hibernation period in those countries. In India the bees do not hibernate, at least in the Plains.

It is clear that with such a short life for workers, in order that the colony may go on, new workers must always be born to take the place of those which die. This actually takes place. New eggs are being laid, new worker brood reared and new workers born every day in the bee-colony. Queens and drones are reared at particular seasons in the year. Therefore by "brood" is ordinarily meant worker brood, drone brood being spoken of specifically as "drone brood."

The Drone.

As will appear from Plate 1, the drone (the male bee) is bigger than the worker and as bulky as, if not bulkier than, the queen. As already explained drones are born from unimpregnated eggs. They are reared in cells similar to worker cells but slightly larger in size in order to accommodate the larger-bodied grubs, these cells being therefore called "drone-cells." Figure 25 shows the worker, drone and queen cells of three kinds of honey bees. Like the ordinary worker-cells, the drone-cells are built in the comb and usually on its lower part and are allowed to remain permanently. Drones may be reared in ordinary worker-cells but then they are dwarfed in size. The egg hatches in three days. The grub is fed with royal jelly for the first three days and then for about four days more, with bee-bread mixed with a little royal jelly. Therefore the food given to the drone grub is richer than that given to the worker grub in order that all his organs may fully develop and he may be a perfectly developed male. The drones are born and come out from the cells after thirteen days from the time they are capped.

The only function of the drone in the colony is to impregnate virgin queens and how this happens we have seen already. Therefore drones appear in the colony only when their services may be required, *i.e.*, when new queens may be produced and require to be fertilized. Consequently in a normal colony drones are not found throughout the year. They help in no work of the colony, but on the other hand eat the honey gathered by the workers, being incapable of gathering even their own food from outside. Therefore the bees tolerate the presence of drones in the colony only whilst they are getting honey and pollen from plants. When the food supply from outside fails, the drones are killed or driven out of the hive after their wings have been maimed, so that they cannot fly back into the hive, and perish. They are not allowed to live the normal period of their life which is probably about two months.

Distinctions between the different members of the Colony.

In appearance and size there is no difference in the eggs. In the grub stage there is no difference in appearance but queen and drone grubs are bigger in size than worker grubs. In the pupa stage the male (drone) and female (queen and worker) bees can be easily distinguished by examining the eyes. In the drone pupa (Figure 7*b*) the eyes meet over the head. In the queen and worker pupa (Figure 7*a*) the eyes are far apart. Without taking out the pupa from the closed cells, it can be easily made out whether there is a drone pupa or a worker pupa inside. The worker pupa is capped with a flat capping and the drone pupa with a convex capping as shown in Figures 8 and 24. Stored honey is also capped in the same way as the worker pupa but the capping of honey has a shiny appearance; the capping of worker brood has a dull dry appearance.

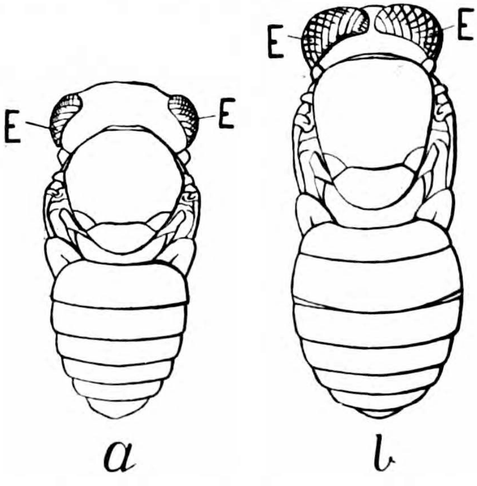

Fig. 7.—(*a*) Worker pupa ; (*b*) Drone pupa ; both viewed from back. (*E*) Eyes.

The capping of the drone brood of the Indian Bee is not only convex but somewhat pyramidal or conical, the top of the cone having a dark spot. There is a minute hole in the middle of this spot for ventilation. In the

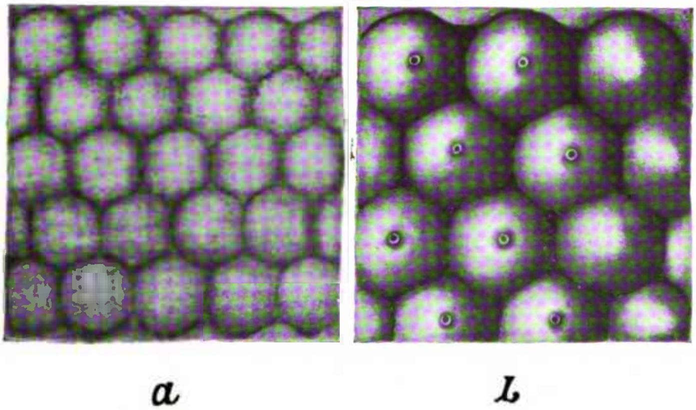

Fig. 8.—(*a*) Capping of worker-cells.
(*b*) Capping of drone-cells; the characteristic capping of drone-cells of the Indian Bee is shown towards the left side. (Also see Fig. 24.)

season of honeyflow, this conical appearance may not be apparent in all cases as the cone is sometimes covered with a layer of wax. But the convexity is not hidden. When the layer of wax is removed the cone with the black spot and hole appears. In the adult stage the distinctions between queen, workers and drones are quite clear (see Plate I). The eyes of the drone meet over the head, those of the queen and worker are far apart as shown in Figure 9. The workers have to gather nectar and pollen from flowers; therefore the limbs used in gathering these substances are modified. They suck out the nectar from flowers with their tongue. Their tongue is therefore more developed and longer than that of either the queen or the drone. The pollen is gathered and carried home on the thighs of their hind legs which are therefore modified and adapted for this purpose and are slightly different in structure from the hind legs of the queen or the drone. Figure 10 shows the hind leg of a worker and also the part where pollen is carried, this part being known as the "pollen basket." The queen and drone have no pollen basket. The workers have to secrete wax with which to build the comb. The wax is secreted through four pairs of structures, called "waxplates" on the under surface

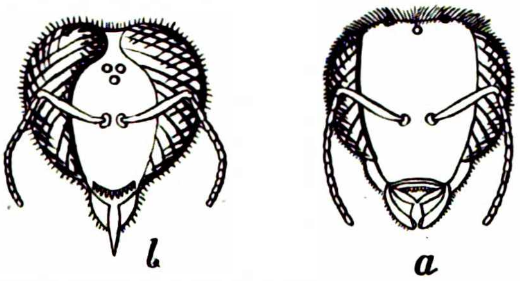

Fig. 9.—Front view of head of (*a*) worker and (*b*) drone.

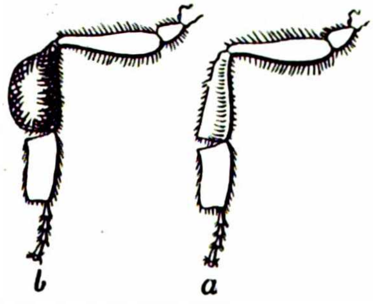

Fig. 10.—(*a*) Hind leg of a worker bee.
(*b*) The same with a mass of pollen on it.

of their abdomen, shown in Figure 11. The queen and the drone possess no wax-plates. The worker has in the sting a powerful weapon of offence and defence. In the queen the sting is slightly modified and is used as the egg-placer or ovipositor as it is called, the egg as it comes out of the abdomen being protruded out through a hole in the ovipositor and placed by it in the proper situation at the bottom of the cell. The drone possesses no sting.

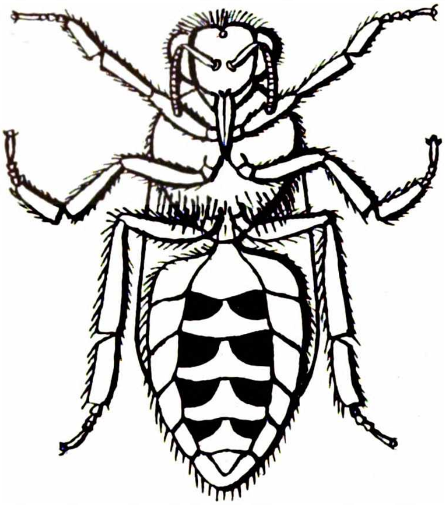

Fig. 11.—A worker bee (magnified) turned on the back to show the wax-plates ; the shaded parts are the wax-plates.

Relative Importance of the Different Members of the Colony.

We can now understand the relative importance of the different members forming the bee colony. A normal colony must have a properly fertilized queen which will lay a large number of eggs every day and there must be a large body of workers able to collect honey, pollen and water from outside, to rear the brood and to perform the various other kinds of work necessary for the well-being of the colony Provided these members are present in an efficient condition drones are not necessary. Of the essential members again the queen alone cannot form or even start a colony, being incapable of secreting wax, building comb, collecting food from outside and rearing brood. The body of workers alone without the queen may continue the colony only as long as they live and the colony will be extinct in the course of about three months when all of them have died off.

A normal colony begins to weaken when the queen, through old age, fails to produce enough impregnated eggs sufficient to replace the workers which die and it begins to dwindle from the time when the queen fails to produce any impregnated eggs on account of the exhaustion of the male sperm in the seminal receptacle and when she dies. In nature the bees (by which the worker-bees only should be understood) foresee the danger and hasten to rear a new queen in time, *i.e.*, before the reigning queen is too old to lay impregnated eggs and before the colony becomes too weak. They build queen-cells and persuade the queen to lay eggs in them and rear several queens although they require only one, in order to guard against emergencies. Before the queens are reared a provision is always made for their fertilization, some drones being reared beforehand so that when the new queens emerge there are drones present to fertilize them. When a young queen is obtained the old queen is killed. When however the queen dies suddenly through some accident the bees rear queens from some of the impregnated eggs laid by the late queen in the worker-cells, the worker-cells round these eggs being demolished and queen-cells built in their place. These new queens take their chance of being fertilized by any drones which may happen to be present in the same or other colonies. If no fertilized queen is obtained the colony is doomed to extinction. The unfertilized queen may live and lay eggs ; but as we know, only drones are born from these eggs. No more workers being born to replace those which die, the colony becomes extinct when all the workers are dead.

When there is no queen in the colony and all attempts to secure one are unsuccessful, one of the workers takes the place of the queen and begins to lay eggs. The worker-bee, as we already know, is an undeveloped female and occasionally she is capable of laying eggs. Such a worker is known as " fertile-worker. " The eggs laid by her, however, not being fertilized, give rise to drones only. Therefore the colony is not saved and becomes extinct in time.

It is more often than not that the colonies succeed in re-queening themselves and if they are successful they may go on for years, colonies being known which are forty years old or even older. But the age of the colony must not be confused with that of the members forming it.

How the Bees recognize the Members of their own Colony.

Every colony has a distinctive smell and the bees recognize the members of their own colony by this smell. If a bee belonging to a different colony tries to enter the hive of a colony, the guard bees promptly attack it at the entrance and drive or kill it. If bees are separated from a colony and kept separate for some time (several hours are enough) they lose the characteristic smell of the colony and will be treated as foreigners when given back to the colony after this period.

Honey and Honey-flow.

Bees do not make honey. Plants secrete a sugary liquid called nectar in the flowers. Bees collect this nectar, sucking it up with their tongue into a pouch in their stomach called the " honey-sac " and then on arrival at the hive disgorging and storing it in the cells of the combs. Certain chemical changes take place in the nectar while it remains in the honey-sac of the bee, converting it into the honey we get. All plants do not yield nectar and those which do, secrete it in minute quantities which, however, vary in different plants. It is not at all times of the year that bees gather honey. Usually there is a particular season when plants secrete large quantities of nectar, it being known as the season of honey-flow. At Pusa and probably everywhere in the Plains the principal honey-flow occurs in spring and early summer from about the end of January to about the end of April, there being a minor unimportant flow in October-November. In the Hills (*e.g.*, Shillong, Darjiling, Nainital, etc.) the principal honey-flow occurs in October-November, and a secondary flow in March-April. It is only in the seasons of honey-flow that the bees get honey to store up. There are periods in the year, for instance, the rains, when very little honey is available. Bees gather honey for their own use as food. They gather much more than they require and in fact they continue gathering as long as nectar is available, as long as they are able to gather it and as long as there is accommodation for it in the combs. We have seen that it is the worker bees which gather honey. Therefore it is evident that the greater the number of workers in a colony the more honey they will gather and store. As it is only in the seasons of honey-flow that plenty of honey and pollen is available, brood-rearing is carried on on a large scale at is time. The population of the colony therefore increases rapidly and it is then that the phenomenon, known as swarming (see page 20) takes place.

Bees and Plants.

In order to be able to understand the relation between bees and plants, it is necessary to know something about how the plants reproduce themselves. The reproduction of plants takes place in one of the following ways :—

(1) A part of the parent plant, root, stem or leaf, is capable of giving rise to a new plant. For instance, bulbs of onion and garlic, tubers of potato, rhizomes or rootstalks of arum, turmeric and ginger give rise to new plants. All are familiar with growing roses, sugarcane and sweet potato from cuttings of the stem. New plants grow from the leaves of Bryophyllum. This kind of reproduction is known as vegetative.

(2) In ferns etc., we find special cells are produced either on the back of the leaves or in their axils and these special cells are by themselves capable of giving rise to new plants. This is known as a sexual reproduction.

(3) The third form is by the production of seeds which, when planted in ground, give rise to new individuals. Such plants produce two kinds of special cells, *viz.*, female cells or ovules (future seeds) in the female organ, the pistil, and male cells or pollen on the male organs, the stamens.

In order to enable the ovules to develop into seeds it is essentially necessary that the contents of the pollen should unite with those of the ovule. The ovule is thus fertilized. For this purpose the pollen must be conveyed to a particular receptive part of the pistil. This is called pollination and fertilization of the ovule follows pollination. The male and female organs, that is, the stamens and pistils respectively, are in most cases located in the same flower which is therefore called bi-sexual. Pollination with pollen of the same flower is called self-pollination or self-fertilization, and that with the pollen of other flowers, cross-pollination or cross-fertilization. Cross-pollination yields more and better seeds than self-pollination. In some cases self-pollination fails to fertilize the ovule and in some cases again it is found to be distinctly injurious. Therefore in nature there are various devices to ensure cross-pollination. Thus a cucumber plant bears two kinds of flowers, some male and others female. The papaya bears either male or female flowers exclusively. In many cases although the flowers may be bi-sexual, having both the organs, self-pollination is prevented by the two organs maturing at different times or by the organs being of such different lengths as to preclude self-pollination or by other mechanisms preventing pollen from falling on the pistils of the same flower. In all such cases pollen from different flowers or different plants must be conveyed through some external agency to the female flowers for the necessary fertilization of ovules, so that seeds may be produced and the species continued.

Pollen may be carried from flower to flower by wind, water, insects or other animals and the plants are classed according to these pollinating agents as anemophilous, hydrophilous, entomophilous or zoophilous, respectively. Of the plants with sexual reproduction a large number is entomophilous, *i.e.*, pollination or rather cross-pollination in them is effected by insects among which honey-bees are included. These plants usually have large, coloured and showy flowers not infrequently possessing characteristic odours and as a further attraction to their insect visitors produce nectar and that too in such a situation in the flower as will ensure the removal of pollen and also the application of some pollen to the pistils by the insects in their search for the nectar. As the insects visit different flowers they distribute the pollen of some flowers to others. The parts of the flowers are sometimes modified to adapt them to the habit of their insect visitors and sometimes the adaptation goes so far as to render the plants capable of being visited by one particular class of insects and by no others. Thus in Australia it was not possible to obtain seed from red clover until the bumble bees were introduced. We see the mutual dependence of plants and insects. The bees, with which we are concerned, depend on the plants for nectar and pollen and the plants too depend on the bees for the necessary fertilization of their seeds. This fact is made of practical use by growers of cucumbers in green-houses in Massachusetts, United States of America. When the cucumber vines are in bloom they introduce and keep in green-houses colonies of bees for getting the crop set, and in this way utilize a large number of colonies. It is reported that in one year 118 growers utilized 944 colonies of bees for this purpose. The colonies thus kept in green-houses usually die as they do not get enough food and fresh colonies have to be purchased and introduced every year. It must be remembered that colonies of bees are always available for sale there, bee-keeping being an established industry.

Pasturage.

Plants affording pollen and honey to bees are spoken of as bee-pasturage. We have seen that all members of the vegetable kingdom do not yield nectar and pollen to bees and also all of the flowering plants may not do the same. For instance there may be whole fields of sann-hemp in full bloom but the honey-bees do not get a single drop of nectar from them. The mechanism of these flowers precludes the true honey-bees, while allowing bumble bees to gather a harvest easily. For similar reasons, all flowers cannot be visited by all of the different kinds of honey-bees. The flowers may be so small that only the smaller bees can thrust their tongue into them to suck out the nectar. Or the nectar may be situated at such a depth inside the flower that only those bees which possess a long tongue can reach it. It is very commonly found that certain flowers are visited by the Little Bee only and by no others. On the other hand some flowers will be found to be visited by all kinds of honey-bees. What constitutes bee-pasturage in a locality has to be found out by actually observing the flowers visited by the honey-bees. Very little work has been done in this direction in India.

Different plants yield different quantities as well as different qualities of nectar. The same plants may vary in these respects in different countries according to the soil and climate. Plants are known which yield abundant nectar in one country but hardly any in another. Similarly the same plants in a particular locality may yield enough nectar in one year but much less in another year according to the change in the climatic conditions. Warm dry atmosphere helps secretion of nectar, a cold wet atmosphere retarding it. Also more nectar is secreted in the morning and evening than in the middle of the day.

It does not pay to cultivate any plants solely for the bees. Plants, which are useful and at the same time yield abundant nectar, may be grown. Or, to put it in a proper way, those who grow such plants will find it profitable to keep bees, as in addition to the outturn of the crop itself, they will have a yield of honey. This practice is often followed in advanced countries. Such crops are usually those which grow densely in a small place and put forth an abundance of flowers. Clover and alfalfa or lucerne, grown for fodder, may be named. An acre of alfalfa in some countries is said to yield as much as 60 lbs. of honey or as the farmers put it "a can of honey (60 lbs.) to the ton of hay." In the same way mustard and sesamum crops in India yield abundant honey.

But the question becomes different when abundant waste lands are available in the neighbourhood where seeds of wild nectar-yielding plants may be grown for the sowing at no great or nominal expense. As it is, however, in India enormous quantities of nectar which is produced by plants both wild and ordinarily cultivated, are wasted because there are not enough and good bees to gather it.

Bees gather honey principally from wild plants, and go to a distance of as far as two to three miles in all directions. But of course the nearer the pasturage the better, as the bees can gather and store more honey when the distance they have to cover in coming and going is small. A few flowering plants cultivated in a garden are no help to them. Usually the flowers cultivated in the garden are mostly made double by cultivation and produce no seed. Therefore they have no necessity for the service of the bees and produce no nectar for them.

Then it has been calculated that in order to obtain about $\frac{1}{28}$ ounce of honey the bees have to visit at least 2,129 flowers of *Rhododendron hirsutum* and 5,530 of sainfoin (*Onobrychis sativa*). From this one can imagine what a large number of flowers are required to secrete nectar and also what a large number of bees are required to gather the nectar in order to have surplus honey. It is evident that though there may be some flowers always available, it does not follow that the bees will gather and store honey. For this purpose there must be abundant pasturage which must put forth an abundance of bloom. This does not always happen and when it happens we have the honey-flow. From the point of view of a practical bee-keeper, a knowledge of the pasturage of his locality and the time when it comes into bloom is very necessary. He can then so regulate his bees as to make the most of the honey-flow when it comes.

Honey-dew honey.

Sometimes bees gather the sugary secretion of plant lice (Aphides) and other insects, known as insect honey-dew, and also a similar secretion of certain plants from extra-floral parts, known as plant honey-dew. This is known as honey-dew honey and is of course much inferior to the floral nectar. So long, however, as nectar is available honey-dew is not collected. In India so far as is known bees get nectar when the honey-dew secreting insects occur and bees will not ordinarily be found collecting honey-dew.

Swarming.

In the case of bees a colony may breed a large number of individuals but as the colony is nothing more than a single family, there is properly speaking no multiplication unless there be an increase in the number of colonies. The bees bring about this increase by what is known as swarming. In the season of plenty, *i.e.*, the season of the honey-flow, when the colony becomes very populous, swarming takes place in the following manner. A number of drones are reared and when the drones begin to fly some queen-cells are built and queens reared. Soon after the first of the queen-cells is capped, all on a sudden in the middle of a bright day a large number of workers, about half of the number present or more, with some drones, fly out of the hive, headed by the reigning queen and go to a new place to establish a new colony. This is called swarming. The flight of a swarm with whirling movements in the air and with a loud humming noise, is a common sight in India in spring and the beginning of the hot weather. The swarm builds combs in the new quarters and is soon established as a normal colony. In the parent colony a new queen is born and fertilized by one of the drones who are already there and takes the place of the old queen. After the first queen emerges the other queen-cells are demolished and their occupants killed. But in some cases the bees in the parent colony wish to send out a second swarm and do not destroy the other queen-cells. The second swarm is sent out usually in about a week after the issue of the first swarm and it is headed by the first-born young queen before she is fertilized. She is fertilized in the new quarters. Similarly several successive swarms may be sent out until the population in the parent colony becomes very reduced. Each swarm goes and selects new quarters for itself.

Migration.

Sometimes bees naturally migrate from place to place. The phenomenon is very common in India. The entire colony leaves the habitation with the combs and settles in another part of the country in one season, returning again in another season. Thus colonies migrate from the Plains to the Hills in autumn and return to the Plains about the middle of the winter. The causes inducing migration are probably changes in the climate but more probably dearth and availability of food supply.

Enemies and Diseases of Bees.

The honey-bees in India have many natural enemies. Three kinds of birds, two green ones known as Bee-eaters (*Merops viridis* and *M. philippinus*—Fig. 12) and the third a black bird with a forked tail, known as the

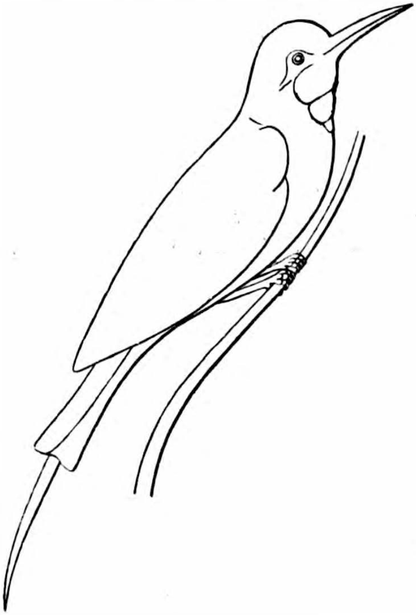

Fig. 12.—The Bee-eater.

King-crow (*Dicrurus ater*—Fig. 13), catch bees on the wing and eat them.

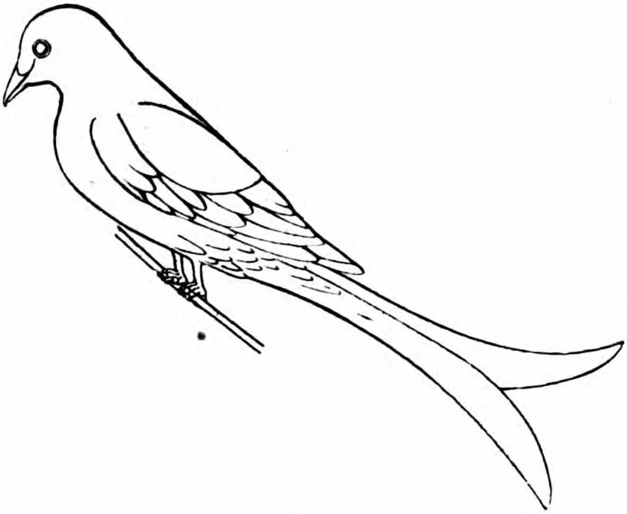

Fig. 13.—The King Crow.

King-crows are not habitual bee-eaters, but some of them develop a strong liking for bees occasionally. Five kinds of predaceous wasps (*Vespa orientalis,* Fig. 14, and *V. cincta* in the Plains and *V. auraria,* Fig. 15,

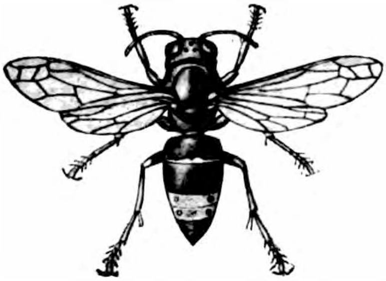

Fig. 14.—The yellow banded brown wasp (*Vespa orientalis*).

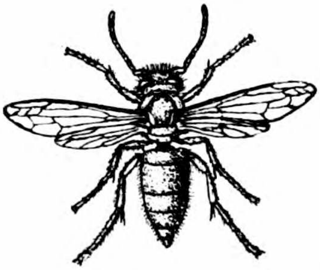

Fig. 15.—The golden wasp (*Vespa auraria*).

Several kinds of ants attack the hives for honey. There is one big moth (The Death's Head Moth, *Acherontia styx,* Fig. 18) which enters hives at night and drinks honey. The worst enemy of the bees in India and specially in the Plains is the Wax Moth (*Galleria mellonella*) of which an account has been published in the *Agricultural Journal of India,* Vol. VI, No. 4. Its life-history is illustrated in Plate III. The moth enters hives at night and lays eggs on the combs. The caterpillars which hatch out of these eggs tunnel the combs forming silken galleries through them (Fig. 19). They eat the combs and fill them with a profuse amount of white silk and black pellets of excreta. Ultimately in place of the combs nothing but a mass of silk and excreta is found. The bees are compelled to desert the hives. The caterpillars pupate inside the comb or in corners of the hive and ultimately come out as moths. In other countries bad and infectious diseases are known which affect the brood and also diseases affecting the adult bees. So far no such disease has been noticed in India and it is to be hoped that they will not be introduced.

The Indigenous Bees.

In India three or rather four kinds of honey-bees are found.

(1) One is the Rock Bee (*Apis dorsata*) the worker of which is illustrated at figure 10, Plate I. It will appear that the worker of the Rock Bee is as big as the queen of the European Bee (*Apis mellifica*). The colonies of these bees build a single huge comb on the face of rocks, on branches of big trees and sometimes on walls of buildings, the comb measuring up to five feet across its face, and being always built in an open place. The bees are very good honey-gatherers and from a single comb of the Rock Bee up to sixty pounds of honey is said to be obtained. But they are very ferocious and do not brook disturbance. Their sting is very painful and several cases of human beings and even big animals such as elephants being stung to death by these bees, are on record. When enraged they pursue their victims for miles. A man cannot escape from them even when he dives in water, as they hover about the place and sting him when he pushes his head out for breath. These bees are known to migrate from place to place. Wild tribes collect their combs by burning away the bees usually at night, some making it a profession to collect their combs. The honey is squeezed out and the comb is melted into wax, each comb on account of its large size yielding a large quantity. The bees-wax exported out of India and running up to the value of more than seven lakhs of rupees in a year is principally obtained from the combs of the Rock Bee. The Forest Department of India realizes a large revenue annually by leasing the right to collect these combs from Forest Areas.

PLATE III.

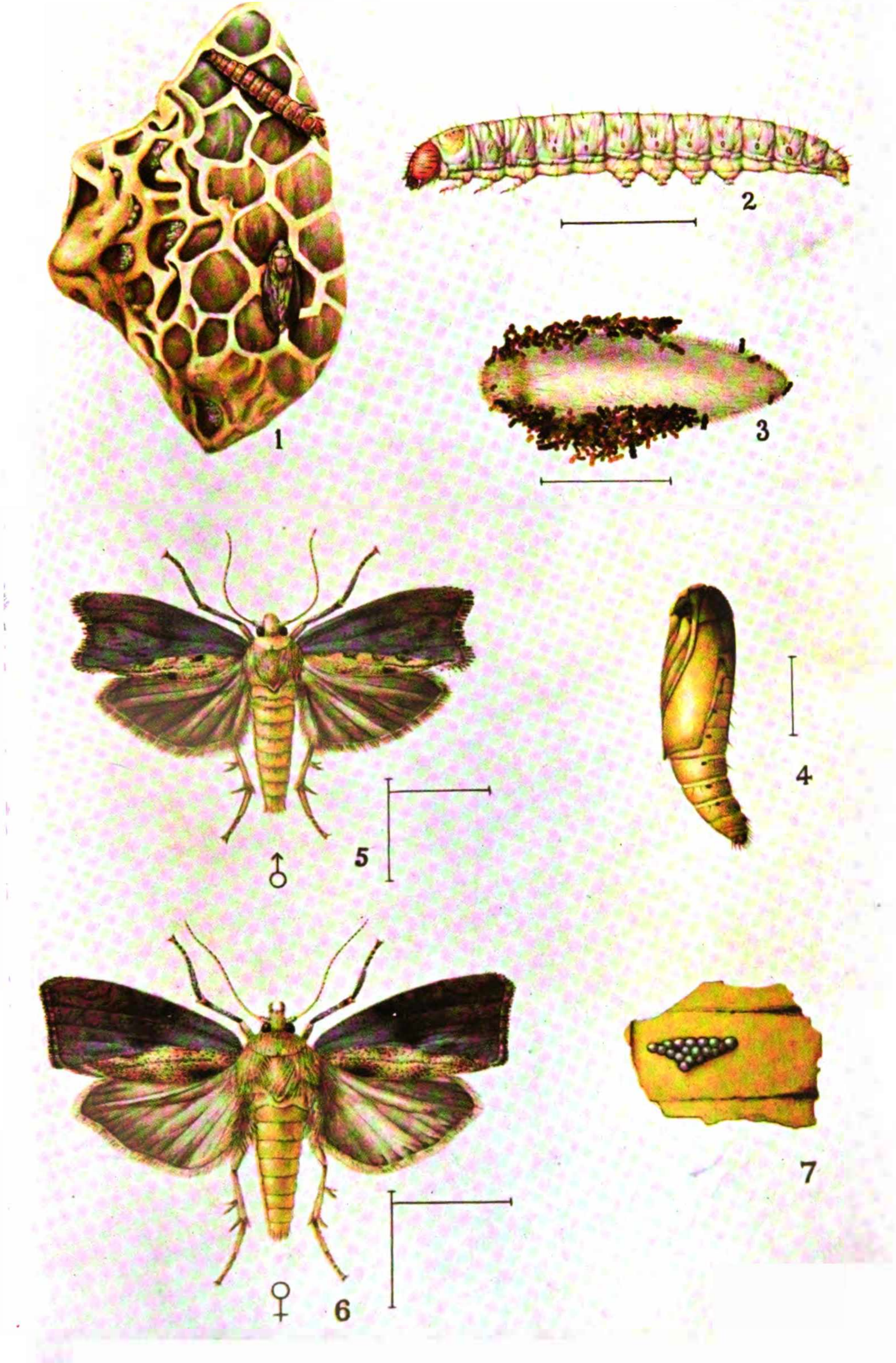

PLATE IV.

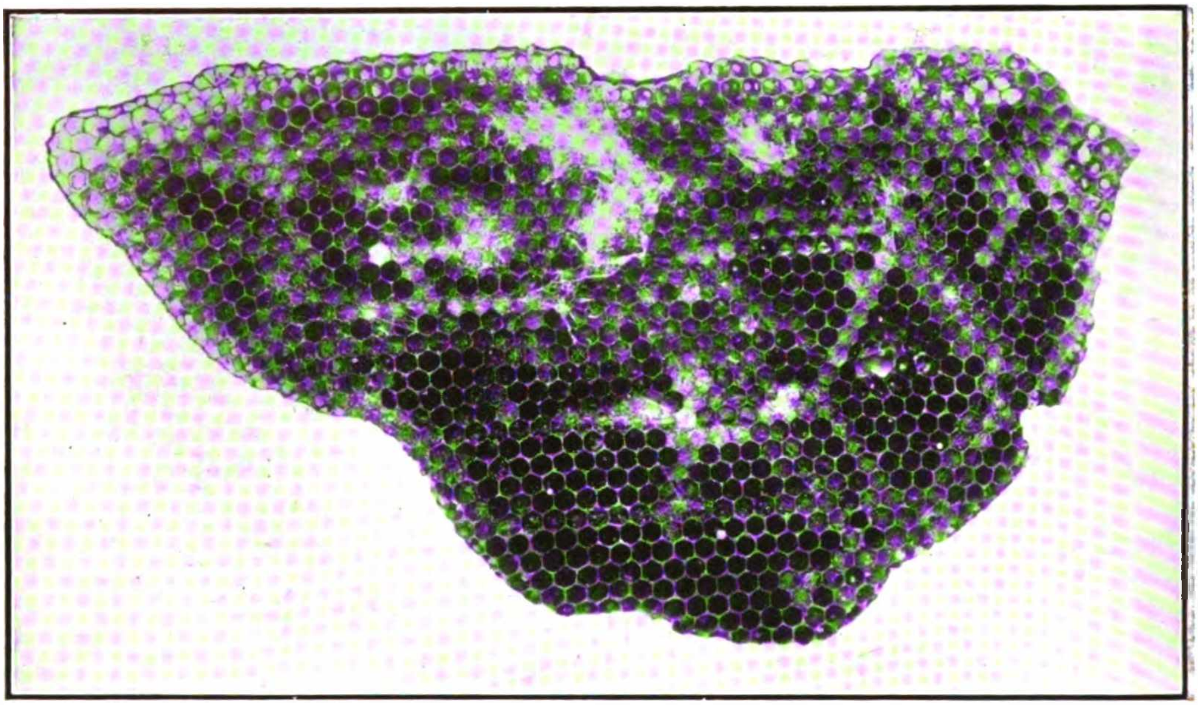

Fig. 19.—A piece of comb attacked by the Wax Moth (*Galleria mellonella*) caterpillars. The galleries of silk and the thin net-like silken covering of the mouths of cells are quite clear. At the upper part at about the middle a thick webbing of white silk has been formed.

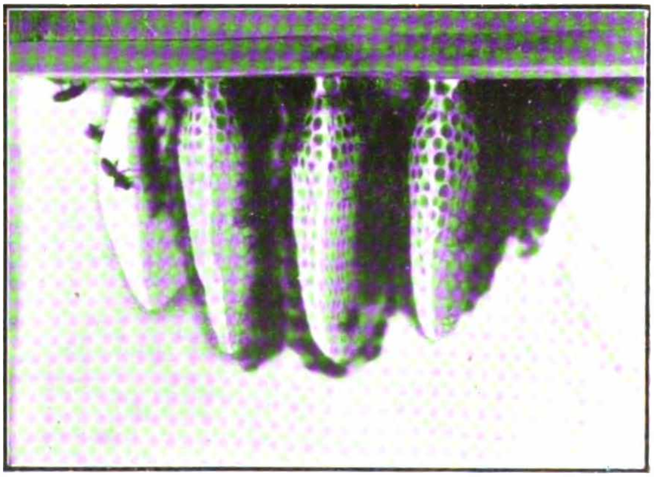

Fig. 20.—Combs as built in nature by the Indian Bee.

(2) The second is the Indian Bee (*Apis indica*). Its queen, worker and drone are painted in Plate I, figures 4, 5 and 6 respectively. They are smaller than those of the European Bee (*Apis mellifica*). The colonies of this bee always live in closed covered places, *e.g.*, cavities in tree trunks or under the ground and in rocks or sometimes in walls. The same habit sometimes leads them to build combs in unused boxes or packing cases. At times they build inside rooms in recesses in walls or windows which are kept shut. They always build several combs side by side and parallel to each other as shown in Figure 20. According to the locality this bee shows a little variation. Thus the variety found in the Hills is slightly bigger and much darker than that found in the Plains. It is not as good a honey-gatherer as the Rock Bee or the European Bee. The maximum quantity of honey obtained from a single colony of this bee in the Plains is about seven pounds when the colony is very big or a little more in the Hills. An average quantity is about six pounds annually. The Plains variety is more irritable and more prone to stinging than the Hill variety. These bees are very prone to swarming and are found to migrate as well to some extent. The Hill varieties, however, show a less propensity to do either. They cannot defend themselves againt enemies so well as the Italian Bees and the Wax Moth plays havoc among them.

(3) The third is what may appropriately be called the Little Bee (*Apis florea*). Figures 7, 8 and 9 in Plate I show its queen, worker and drone respectively. Its worker is much smaller than that of the Indian Bee. Compared with the worker, the queen and the drone are very big but smaller than the queen and drone of the Indian Bee. The colonies of this bee build a single comb which is usually not larger than the outstretched palm of the hand but attains to a much larger size occasionally. The comb is usually built in bushes as shown in Figures 21 and 22 and hung on some branches. Frequently, however, the bees are found to build under eaves of huts and cornices of buildings and walls, in ventilator holes of houses and behind doors and windows. In the last named situations the comb is built parallel to the wall in such a way that it does not interfere with their opening and closing. Figures 23 and 24 show a comb built at the end of a log of wood in a fuel stack. The bees are not so prone to sting and have therefore been styled " stingless " by several writers. Actually they do sting and cause swelling though the injury is not so painful as that caused by the bigger bees. They gather very small quantities of honey, a single comb yielding only a few ounces.

(4) The fourth is a small bee, smaller than the Little Bee. It is called the Dammar Bee (*Melipona* spp.). These bees are classed with the Honey Bees because they collect very small quantities of honey which is supposed to have

medicinal properties. But they do not secrete any wax to build their combs which are constructed with gums and resinous substances collected from plants and allied to propolis of the true Honey Bees. The combs are built in hollow walls or tree trunks and usually are extended beyond the opening of the hollow in the form of a funnel. The combs yield what is known as "Bees Dammar" or "Pwe-nyet" in Burma, which country has a small inland trade in this substance. The Bees Dammar may be used in varnish and is used in Burma for caulking boats to make them water-proof. The right to collect the combs is leased out by the Forest Department every year and yields an annual revenue of about Rs. 5,000.

The European Hive Bee.

The Honey Bee of Europe is known to Science as *Apis mellifica* (meaning honey-maker) or otherwise as *Apis mellifera* (meaning honey-bearer). It occurs also in Western Asia and Africa. Like the Indian Bee (*Apis indica*) it is found to vary a little in colour, some being darker than others, and also in size and temperament according to localities. In nature the colonies of this bee again like its Indian congener build several parallel combs side by side and in sheltered closed situations, *i.e.*, cavities in tree-trunks and rocks or underground. It is however a very much better honey-gatherer and much less prone to swarming. Figures 1, 2 and 3 in Plate 1, show respectively the queen, the worker and the drone of the Italian variety of the European Bee. The Italian Bees, as they are commonly called, have been found by long experience to be more industrious, more peaceful, therefore less prone to stinging, and more able to guard their colonies against natural enemies, than any of the other varieties. They successfully protect their combs against the Wax Moth. Their queen too is more prolific and therefore the population in their colony is always strong and regains strength quickly even when weakened. On account of these qualities the Italian Bee is rapidly gaining ground everywhere and replacing other bees wherever introduced, not only in Europe but also in America, Africa, Australia and New Zealand, *i.e.*, in countries where bee-keeping is carried on on modern lines.

Which Bee is capable of being kept in Artificial Hives.

Artificial hives are nothing but wooden boxes so designed and made as to afford bees protection against sun, rain, cold and enemies, at the same time allowing them facilities to build combs inside and to go out to collect and bring in the necessaries of their life, *viz.*, honey, pollen and water. Artificial hives are shelters for the bee colonies and are really imitations of their

PLATE V.

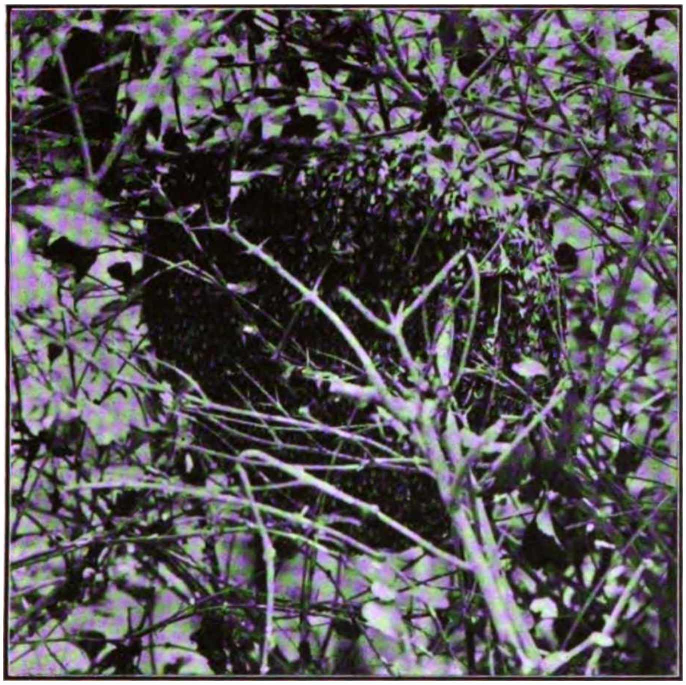

Fig. 21.— A colony of the Little Bee in a bush.

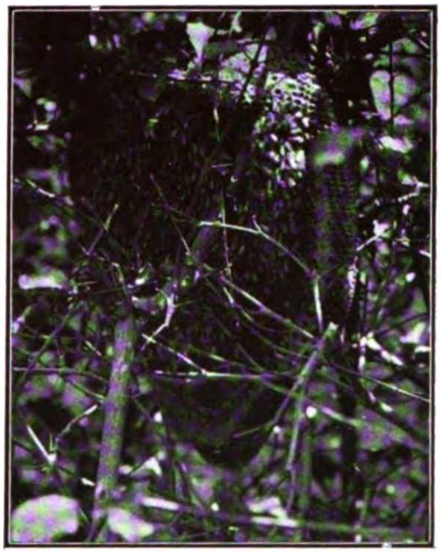

Fig. 22.—The same as Fig. 21, the bees being made to recede to expose the comb.

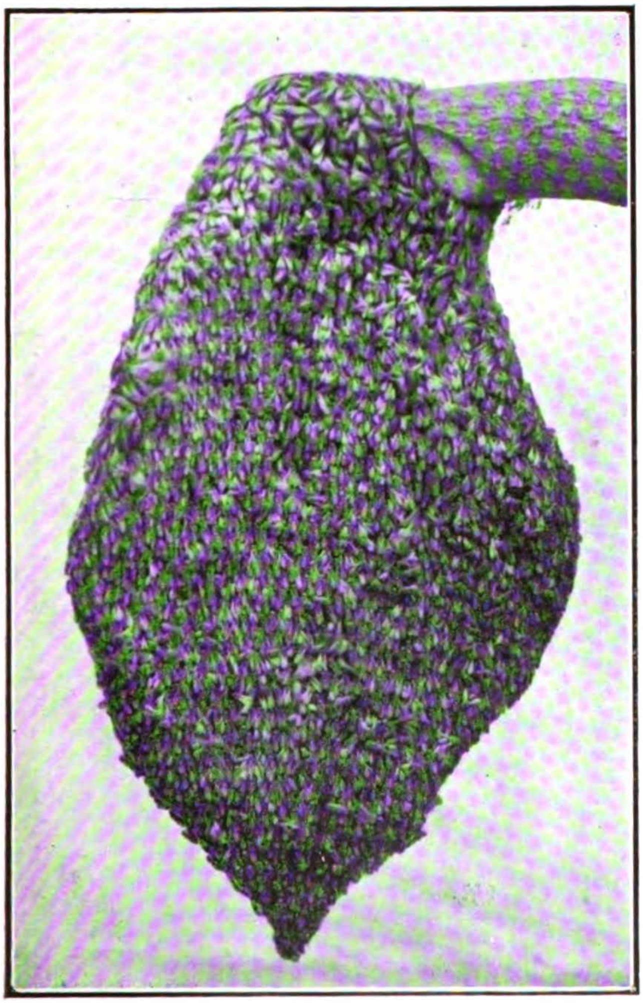

Fig. 23.—A colony of the Little Bee at the end of a log of wood.

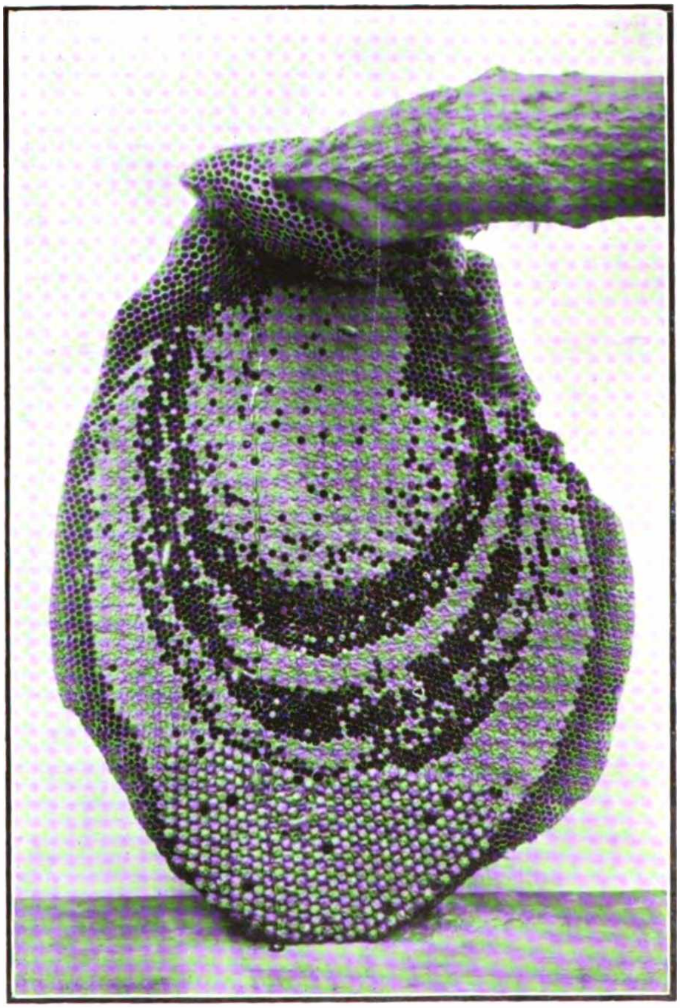

Fig. 24.—The comb of the colony shown in figure 23. The flat capping of worker brood and convex capping of drone brood (at the lower part) are quite clear.

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natural abodes, *viz.*, cavities of rocks and tree-trunks. Therefore, of the bees we have mentioned, only those which live in such shelters in nature are capable of being kept in artificial hives, *viz.*, the European Hive Bee (*Apis-mellifica*) and the Indian Bee (*Apis indica*) Hence they are designated as "Hive Bees." The Indian Rock Bee (*Apis dorsata*) and the Little Bee (*Apis florea*) are lovers of open air and cannot be kept in enclosed boxes; also they build only single combs and are therefore not adapted for hives. Bee-keeping may be described as inducing hive bees to live in artificial shelters or hives under control. In advanced countries there have been various improvements in bee-keeping, all directed towards enabling the bees to gather more and more honey. Of the honey gathered, the bee-keeper takes the surplus over the requirements of the bees themselves. Therefore the more the honey gathered by the bees the greater the profit of the bee-keeper.

Which bee to keep.

As pointed out, of the three indigenous bees of India, only the Indian Bee is capable of being kept in artificial hives. The pictures given will enable it to be distinguished easily. Besides if it is remembered that this bee builds several parallel combs at the same place, no mistake can be made. The Rock Bee and the Little Bee build only one single comb. The qualities which make hive bees desirable are the following :—

1. They should be peaceful in temperament and not prone to stinging, and so easy to handle.

2. Their queen should be very prolific so that the population of the colony may be kept up to a good strength and in the season of honey-flow there should be a very large body of workers able to gather large quantities of honey.

3. They should be good honey-gatherers.

4. They should be able to guard the colony, specially against the Wax Moth, of all the enemies. The bee-keeper can help them against the other enemies but it is hardly possible for him to prevent the Wax Moth from creeping into the hive and infecting the combs at night.

5. Above all, they should not be prone to swarming. If they are prone to swarming, they will never yield a large quantity of surplus honey even if they possess in a high degree all the other qualities. As has already been explained the greater the number of workers in a colony, the more the honey gathered and stored. Swarming divides and therefore weakens the colony and this takes place in the season of the honey-flow, that is, just at the time when plants secrete nectar in sufficiently large quantities. Bees prone to

swarming will swarm just when their number has increased and they are in a condition to gather this nectar.

In all these qualities the Italian Bee excels.

The Comb.

As already explained, the cells of the comb are used as cradles for the earlier stages of the bees and as store-houses for honey and pollen. In nature the honey is usually stored in the cells at the upper part of the comb, about the upper third, brood-rearing being done in the lower portion. The store cells are the same in size as the worker cells and as the brood necessary to be reared is mostly worker brood, the major portion of the comb consists of worker-cells. Drone cells are built towards the bottom while queen-cells, when necessary, are built on the margin. (See Figure 25). Both drone and worker cells may be utilized as store-cells. Pollen is stored here and there in certain cells among the brood. The stored pollen looks like a yellow paste and can be easily distinguished. The comb is built with wax secreted by the worker bees. For secreting wax the bees gorge themselves with honey and sit quietly in a cluster thus keeping themselves warm. Wax oozes through the wax-plates (Figure 11) and collects on them in the form of white scales which are scraped off and moulded and worked into combs with the help of the jaws. It has been calculated that according to season, bees eat from 7 to 15 lbs. of honey to secrete one pound of wax. Therefore comb-building is usually done when enough honey is available.

As the different varieties of bees vary in size, the sizes of the cells of their combs also vary. The comparative sizes of the cells of the combs of the Italian, Indian and Little Bees are illustrated in Figure 25.

In the linear inch are included about 4¾ worker-cells of the Italian Bee, 6 worker-cells of the Indian Bee and 9 worker-cells of the Little Bee. The worker-cells of the Italian Bee are about equal in size to the drone cells of the Indian Bee and the worker-cells of the latter are about equal to the drone cells of the Little Bee. The worker-cells of the Rock Bee are about equal to the drone cells of the Italian Bee, 4 or 3¾ of which come in a linear inch. Similarly the thickness of the comb is different in the different varieties. It is therefore clear that combs of one variety of bees cannot be used by another variety.

The prevalent condition of bee-keeping in India.

As already explained the Rock Bee and the Little Bee are not capable of being kept in hives. They live in a wild state and the honey and wax from

EXPLANATION OF PLATE VI.

Fig. 25.—**A.** Comb of the Italian Bee; a few drone cells are seen near the lower margin; an old open queen-cell is shown separately on the left.

B. Comb of the Indian Bee; many drone cells are seen in the lower portion on the right hand side; an open queen-cell is shown separately on the left side.

C. Comb of the Little Bee; drone cells are seen at the lower part; three open and somewhat mutilated queen-cells are seen in the natural position.

D. Workers of the Italian Bee, the Indian Bee and the Little Bee (left to right) to show their comparative size.

PLATE VI.

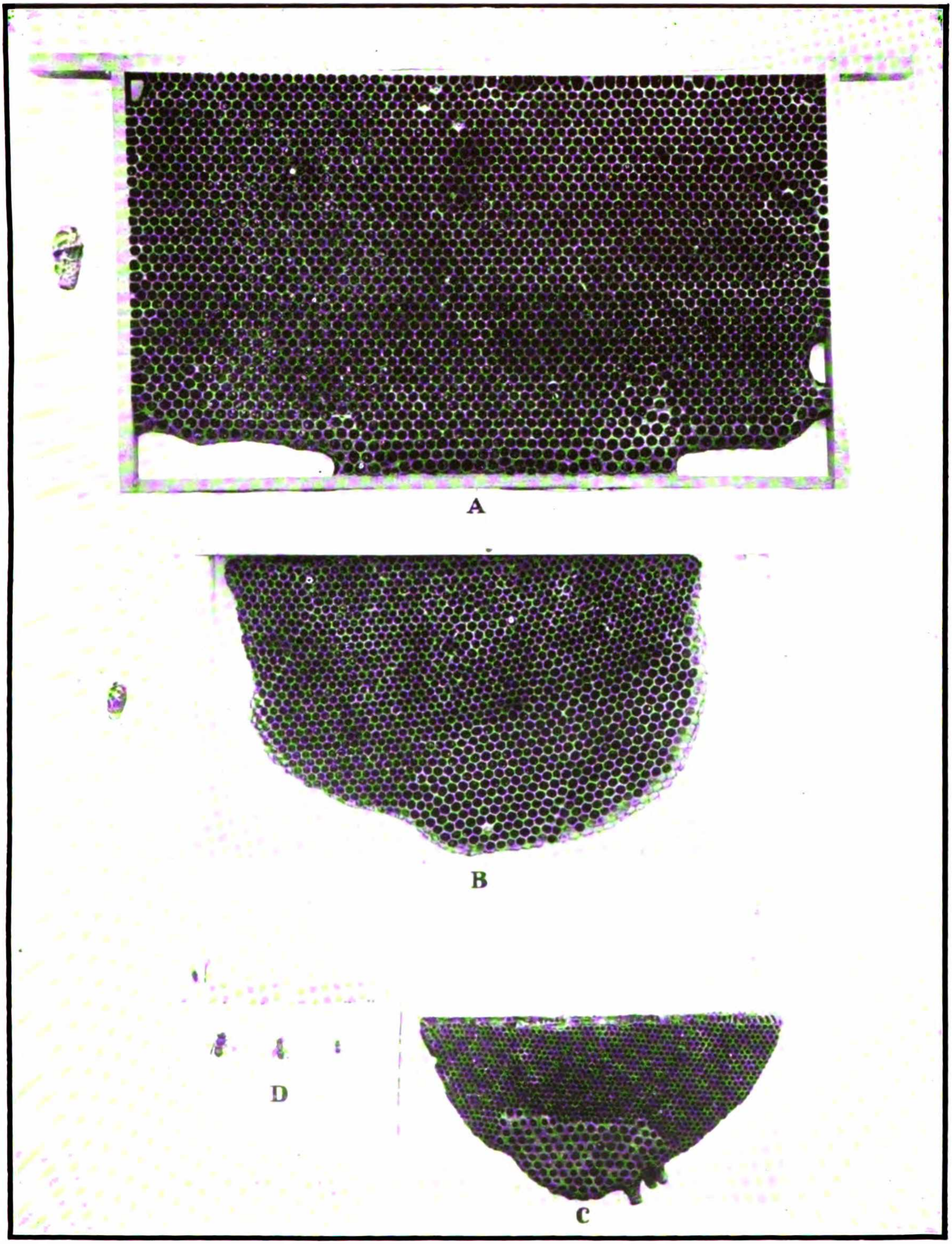

Fig. 25.—Combs of various bees.

their combs are collected in the proper season. They will most probably remain as they are and unaffected by any improvement and progress of bee-keeping in India. The Hill varieties of the Indian Bee being more amenable to control and less prone to swarming and migrating than the Plains varieties, from time immemorial they have been kept by the inhabitants of the Hills. The hive used is not however much of an improvement upon their natural abodes, *viz.*, cavities in tree-trunks and rocks. In the Khasi Hills and in some parts of the Eastern Himalayas the hive used is a thick log of wood, measuring about a yard in length and about 1½ ft. in thickness, which is hollowed out and the ends closed with planks leaving a small opening at one end for the bees. These "log hives" are placed horizontally either on the ground or hung on to the eaves of huts. Practically all over the Himalayas up to an elevation of about 7,000 feet the hive used is an oblong niche or recess in the wall inside the house having a small opening on the outside forming the entrance hole for bees, the recess itself being closed with a hinged plank which can be opened or shut when necessary. Thus there is a closed chamber and the bees build combs from its ceiling. The third type of hive used is either an ordinary earthen pitcher turned upside down, for instance, in Coorg and Mahableshwar or other forms of earthen vessels, hemispherical or cylindrical, as in some parts of Baluchistan. These earthen or pottery hives are either placed on the ground or on branches of trees. Sometimes old packing cases or tea-packing chests are taken possession of by the bees which are then allowed to live in them.

The methods too of keeping the bees are primitive. The bees build combs fixing them permanently on the ceiling of the hive chamber. When they store honey they are usually smoked out or sometimes burnt and the combs containing honey are cut out, the honey being afterwards squeezed out and the squeezed combs melted into wax.

Bee-keeping is practised nowhere in the Plains although bees occur plentifully in some places, building combs in cavities in trees and walls and in unused boxes. In many places, for instance, in the neighbourhood of Pusa, there are professional bee-men known as *Koeris* who, in the months of April and May, go about extracting honey from these wild combs. The owners of the boxes, houses and trees get half the quantity of the honey extracted. All the combs are cut out, the portions containing the brood are rejected and those containing the honey are squeezed. This honey the *Koeris* hawk about, selling it at 5 to 8 lbs. per rupee. The honey contains many impurities in the shape of wax, pollen and certainly also the juice of some eggs, grubs and pupæ. Therefore it does not keep and ferments quickly and is ultimately reduced to the condition of a thin and not infrequently sour syrup.

Large quantities of honey are similarly obtained from the combs of the Rock Bee.

Besides the professional hawkers there are dealers in Calcutta alone who sell about 60,000 to 70,000 lbs. of this thin fermented honey at about the same rate as mentioned above. There is no export trade, the whole of this quantity finding its way into villages where it is stocked and sold by grocers. The honey produced in the Hills is of a better quality and is obtained in a thick granulated condition. It is sold at 8 annas to 10 annas per pound. That produced in the Darjiling Jail is sold at the very high rate of a rupee a pound.

There have been several attempts by private gentlemen and missionaries at keeping the Indian Bee in the modern European methods. But they have either not been successful or have not given better results than the prevalent indigenous methods principally, it appears, for want of proper appliances. Without these appliances bees cannot be properly controlled.

Modern bee-keeping.

In the following pages the modern advanced methods of bee-keeping are described with detailed instructions about making the hives and appliances necessary and about the proper management of both the Indian and the Italian Bees. The improved methods are directed towards bringing the bees as much under control as possible, giving them facilities for gathering and storing larger quantities of honey so that larger surpluses may be obtained and securing the surplus in as pure a condition as possible. The principal improvements in appliances may be briefly enumerated as follows:—

(1) *The movable bar-frame hive.*—The bees are made to build combs separately in wooden frames and all the combs in a hive are capable of being taken out, examined and reinserted whenever necessary.

(2) *The honey-extracting machine.*—The combs built by the bees are not broken or destroyed. The honey stored in them is taken out or as it is called "extracted," in a machine and the combs given back to the bees to be used by them again. Therefore the bees are not required to build fresh combs every time and are thus saved from secreting wax which involves time which can be otherwise usefully devoted in gathering honey and also involves consumption of large quantities of honey. Therefore by preserving combs the bee-keeper increases the surplus.

PLATE VII.

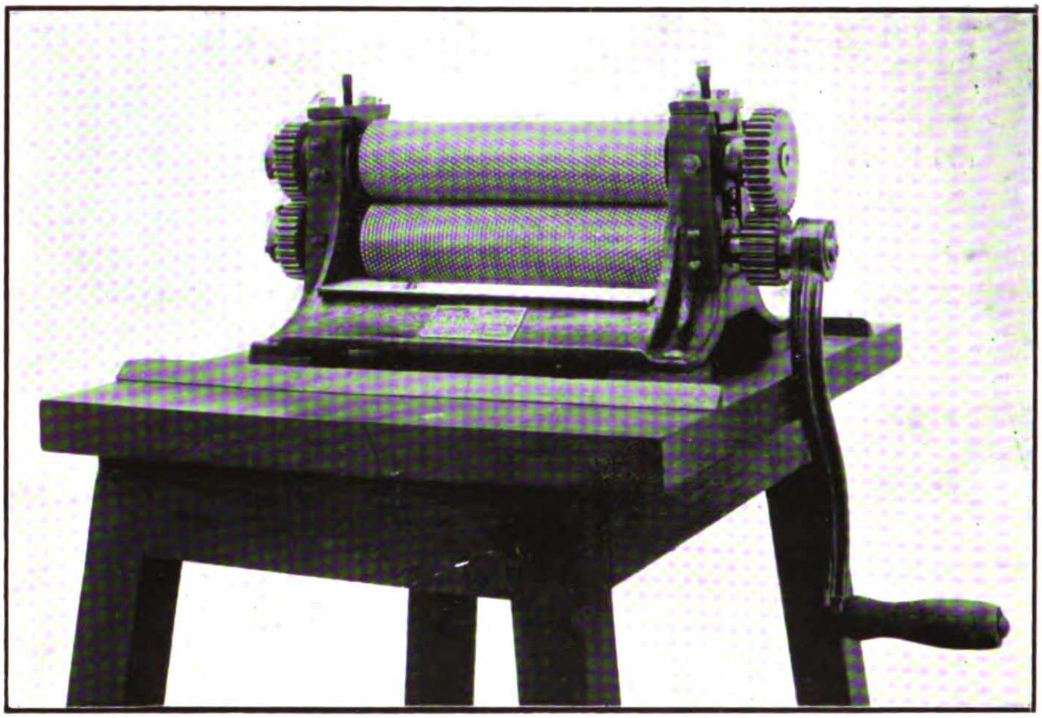

Fig. 27.—Comb foundation mill.

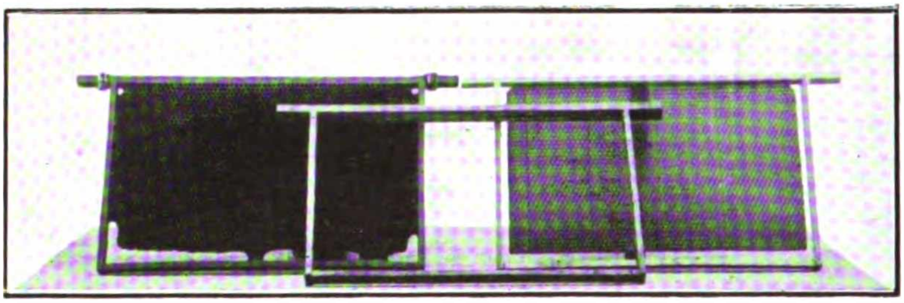

Fig. 28.—An empty frame in the middle. The frame on the right is fitted with a sheet of artificial comb-foundation. On the left a comb built on such a foundation in a frame.

(3) *Artificial comb-foundation.* (Figure 26).—In order further to save the bees from secreting wax, a thin sheet of wax is provided on which the bees build the comb. The bases of the cells of the future comb are artificially imprinted on this sheet by passing it through a special roller machine (Figure 27). In order to build the comb the bees have only to add the walls of the cells. They have to secrete a certain amount of wax no doubt but they use much of the wax provided in the comb-foundation. As the cells of the combs of the Italian and Indian Bees are different in size the foundation ought to have the cell-bases of the proper size imprinted on it to suit either. Figure 28 shows an empty wooden frame, a frame fitted with artificial foundation and a comb built on such a foundation in a frame.

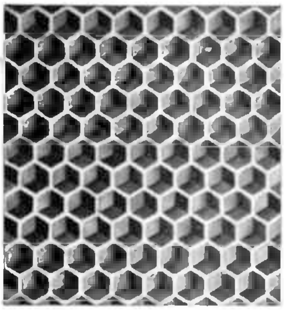
Fig. 26.—Artificial comb foundation.

(4) *The queen-excluder.*—In order to secure honey free from brood and pollen, the queen is prevented from having access to some combs in the hive by means of a perforated zinc sheet. Workers can easily pass through the perforations and store honey in these combs but the queen being larger in size cannot pass through them. This is known as the "queen excluder" zinc sheet. By using the queen-excluder the bees can be made to store only honey in some combs, no eggs being laid in them as they are out of reach of the queen. As pollen is stored in combs in which brood is being reared, these combs being free of brood, remain free of pollen as well. The honey is thus obtained in a pure state, free from pollen and juice of crushed brood which is sure to be injured in the process of extracting honey if present in the comb. As the workers of the Indian Bee and the European Bee are different in size, different sizes of perforations are necessary to adapt the queen-excluder to either. For the European Bee the perforations measure $\frac{3}{4}$ inch × $\frac{1}{6}$ inch. For the Indian Bee they measure $\frac{5}{32}$ inch × $\frac{5}{8}$ inch.

The Hive.

The log and pottery hives at present used in different localities should be replaced by movable bar-frame hives.

The Kerosene-box Hive.—A cheap hive can be made from ordinary kerosene packing cases. Such a hive is illustrated in Figure 29. A wall is

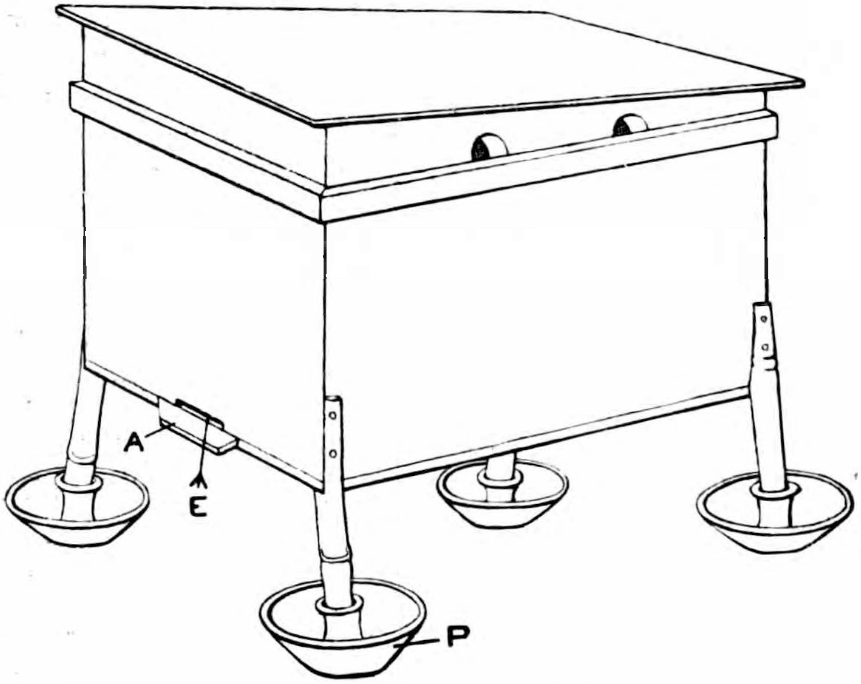

Fig. 29.—Kerosene-box hive.
E. Entrance. A Alighting board for bees.
P. Ant-preventer (it is kept filled with water).

added inside along each of the longer sides as shown in Figure 30. The frames of combs are supported on the top of these inside walls as shown in this figure. A hole is made at the bottom at one end and a small piece of

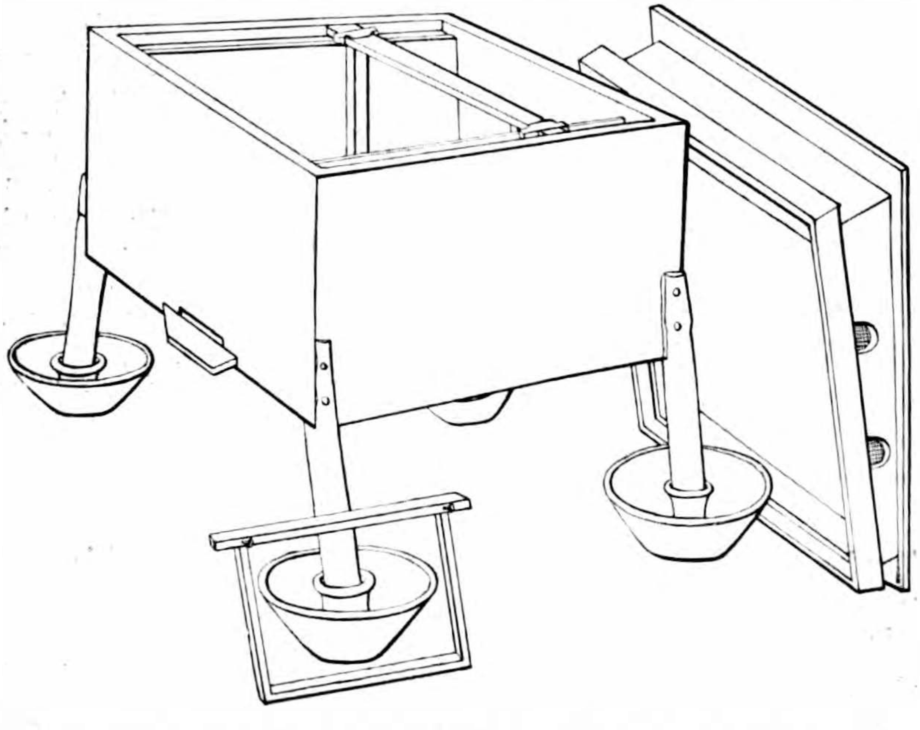

Fig. 30.—Kerosene-box hive opened; with one frame in position and another outside.

wood nailed below; it forms the alighting board for the bees. Four pieces of bamboo are nailed on to the box and form legs. The cover, or roof, is made sloping and is covered by a piece of tin cut from an ordinary kerosene tin. This prevents rain from getting in. Such a kerosene-box hive may do well in the Plains. But in the Hills where there is too much rainfall and also severe cold, it does not afford sufficient protection to the bees. The measurements of the frames used for this hive are given in Figure 39. This frame should be adhered to in every case. The inside measurements of this hive are given in Figure 31. The kerosene boxes vary a little in size, but by varying the position and height of the newly added inside walls, these measurements can be obtained. The longer standard frames (Figure 40) cannot be used in the kerosene box-hive, but they can be accommodated lengthwise by adding two more walls along the shorter sides of the box, so as to make a chamber 14½ to 15 inches in length.

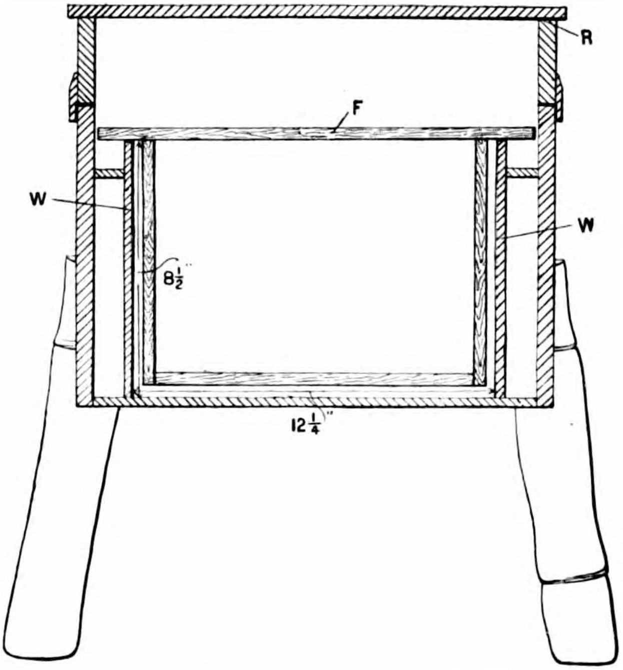

Fig. 31.—Section through the Kerosene-box hive to show measurements. R. Roof. F. Frame for comb. W. Walls which are added inside.

The Standard Hive.—Bee-keepers will find by experience that it will give more satisfaction and pay in the end to make a hive with well-seasoned *deodar* wood or any other wood which will not warp or in other ways be affected by changes of seasons. When making a hive with such wood it is always advisable to make it of the standard pattern shown in Figures 32—35. The standard hive is so made that its parts can be separated as shown in Figure 33. The bottom, or as it is called "floor board," has four legs

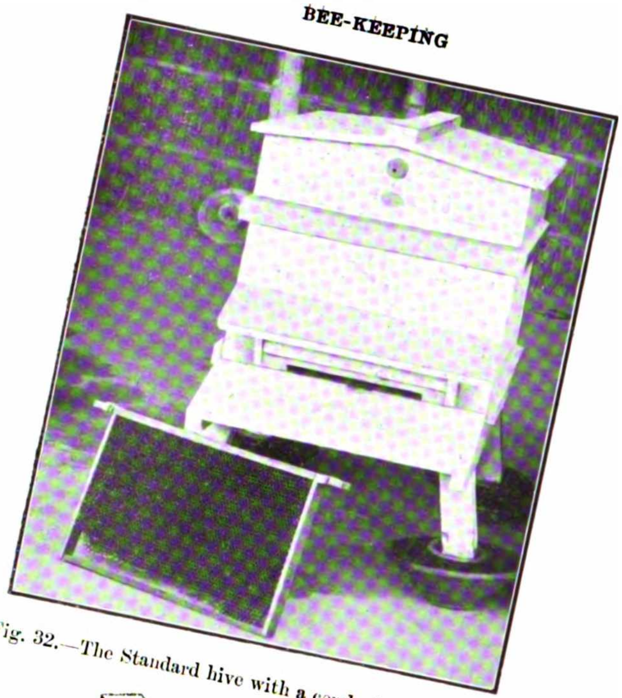

Fig. 32.—The Standard hive with a comb shown outside.

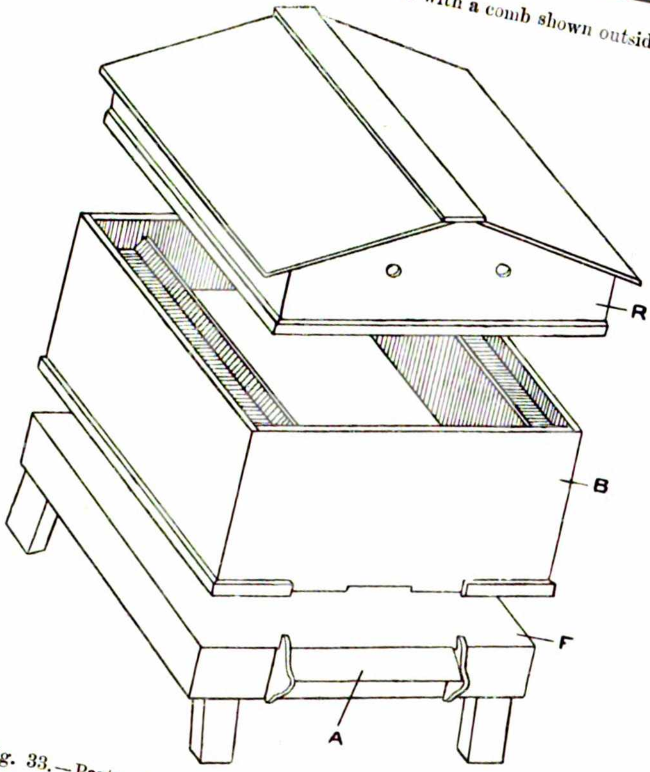

Fig. 33.—Parts of the standard hive shown separately.
R—Roof. B—Body box or hive chamber.
F—Floor board or bottom of the hive. A—Alighting board for bees.

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fixed to it and a piece of sloping board in front of the entrance to serve as an alighting board for the bees. The combs are contained in the hive chamber or "body box" as it is called, and are supported on the top of the two inner walls. The roof rests on the body box. The measurements of the standard hive are given in Figures 34 and 35 and those of the standard frames for use in this hive are given in Figure 10. When the hive is placed in the open air a porch or portico above the entrance may be added as seen in Figure 32.

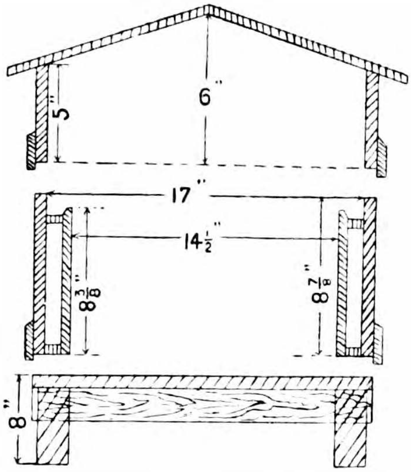

Fig. 34.—The standard hive, section from side to side.

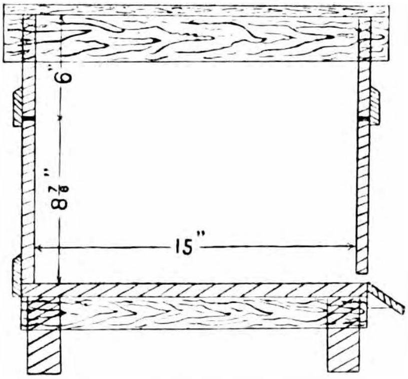

Fig. 35.—The standard hive, section from back to front.

The Wall Hive.—The wall hives with a little modification can easily be adapted to the use of moveable bar frames and then they will be superior to any wooden hive, considering the severe winter prevalent in the places where wall hives are used. In Western Countries there is great difficulty in keeping bees warm in winter. When the hives are left outside they have to be wrapped in warm materials. In order to minimize the difficulties in thus attending to every hive, special cellars are in many cases prepared into which the hives are carried and stacked. In the case of the wall hives there is no difficulty in this respect. In places with severe cold, wall-hives will serve the purpose well and will be found equally efficacious in the Plains. In order to be able to use movable bar frames in a wall hive, it should be made correctly according to measurements which are given in

Figure 36. It should be made as it is now done but with the modifications according to the measurements given. There should be grooves at correct heights and into these grooves a movable frame carrying combs will be put

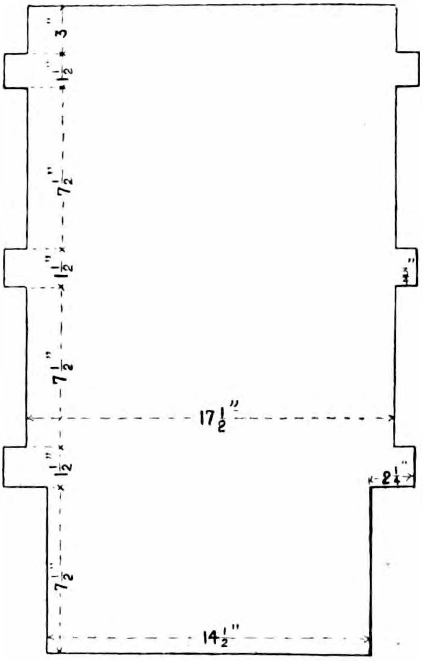

Fig. 36.—Measurements of the wall hive.

in. The frame of combs can be inserted or drawn out as shown in Figure 37. Every 9 inches will accommodate one layer of standard frames. Therefore in the hive recommended three layers of combs can be put in when necessary. The lowest chamber will ordinarily be used for the Indian Bee. The Upper chambers will be required for use when Italian Bees are introduced. All the standard appliances of the British Bee-keepers' Association can be used without any modification.

The hive can be made 30 inches high. For 7½ inches from the bottom the breadth will be 14½ inches. Then there are two grooves to receive a comb-carrier frame. Above this the breadth will be 17½ inches. In order to accommodate 10 combs for Italian Bees in each chamber the depth

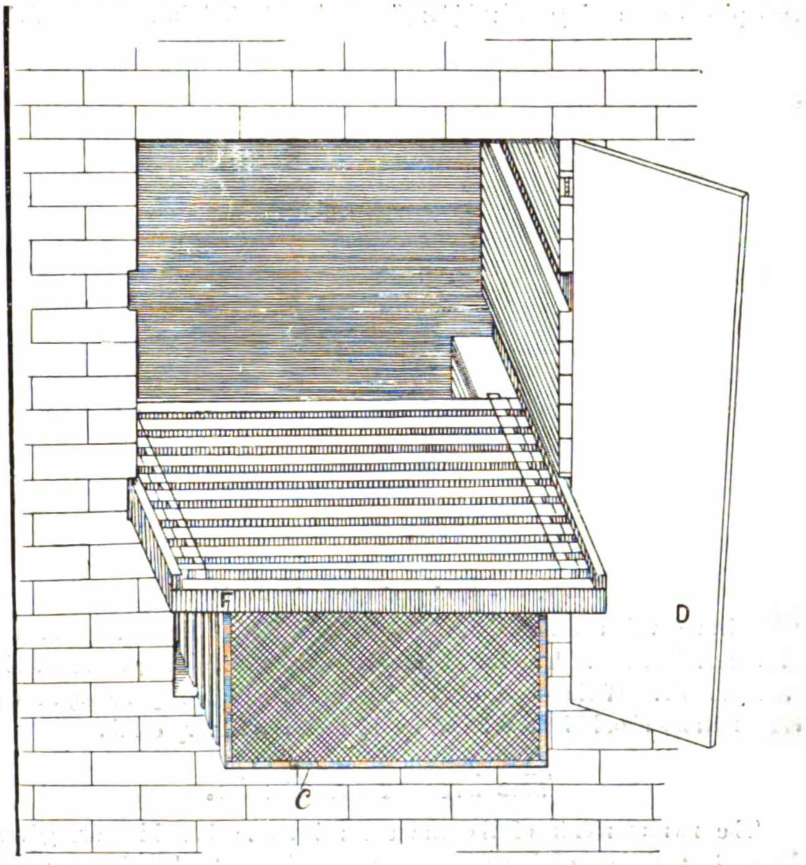

Fig. 37.—Movable bar-frame wall hive. The door (D) has been opened and the comb-carrier frame (F) with the combs (*c*) in position has been half drawn out.

of the hive should be 15½ inches. Every 1½ inches accommodates one comb and the depth can be decreased accordingly if the thickness of the wall does not allow of full 15½-inches. The walls and floor should be made smooth and level and all the corners well made. A correct make is essentially necessary for smooth working.

When it is necessary to examine the hive the hinged door is opened and the comb-carrier frame drawn out (Fig. 37) and any comb taken out and examined. It is not necessary to draw off the carrier frame entirely from the grooves. It is held in position even when more than three-fourths pulled out and both the hands of the operator are free to examine combs.

The comb-carrier frame for the wall hive is illustrated and its measurements given in Figure 38. A A are two pieces of wood 15″ × 2″ × 1″. Over them are placed two pieces of wood B B measuring 15″ × 1″ × ½″. C C are two pieces measuring 19″ × 1¼″ × ½″ nailed on to A A in the manner shown.

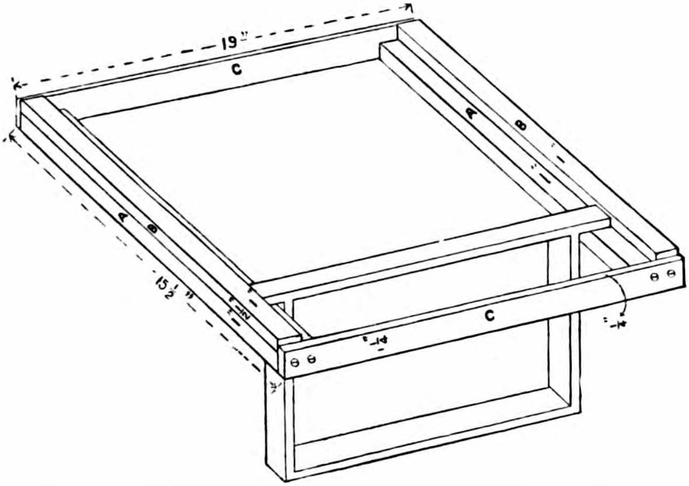

Fig. 38.—Comb-carrier frame for wall hive.

This frame will accommodate 10 combs of Italian Bees and 12 combs of the Indian Bee. The frame carrying combs runs into grooves as shown in Figure 37. If the depth of the hive cannot be full 15½ inches, the comb-carrier frame should be shortened by 1½ inches for every comb.

The Frames for Combs.

The measurements of the frame for kerosene box hive are given in Figure 39 and those of the standard frame in Figure 40. The frames are made

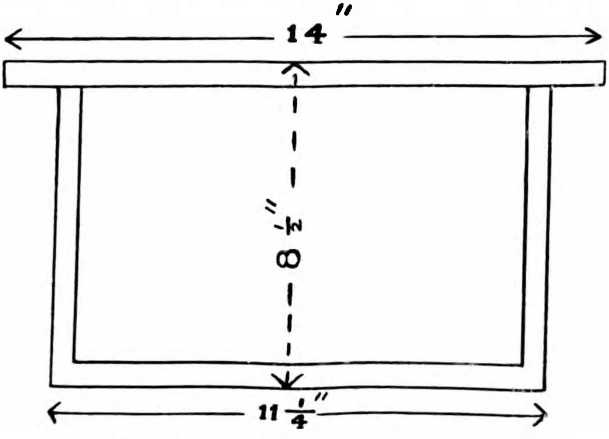

Fig. 39.—Measurement of frame for Kerosene-box hive.

with strips of any well-seasoned wood which will not warp, well-seasoned deal-wood being the best. The strips are made ⅞ inch wide and ⅜ inch

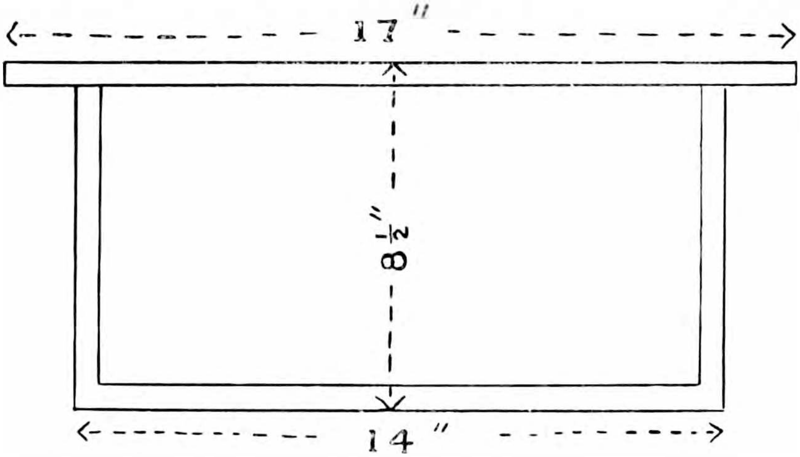

FIG. 40.—Measurement of standard frame for use in standard and wall hives.

thick and are cut and fitted up to make a frame according to the measurements given. The side and bottom bars may be made ¼ inch thick. The projecting portions of the top bar rest on the inner walls of the hive. In the standard frames manufactured and sold, there is an open slit along the middle of the top bar to receive the sheet of comb-foundation. It is not advisable to have this slit as it affords a very convenient hiding place for the Wax Moth caterpillars. A small groove about $\frac{1}{16}$ inch deep along the middle of the under surface of the top bar (Fig. 41), serves the purpose very well for adjusting the foundation sheet.

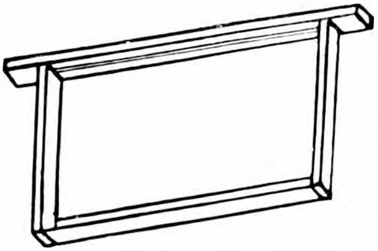

Fig. 41.—Frame with groove along the middle of the under surface of the top bar.

How Bees can be made to build Combs in Artificial Frames.

In nature the parallel combs are built at a regular distance leaving enough space between them for the bees to walk over the contiguous combs. In the case of the Italian Bee the distance between the centres of the contiguous combs is about 1⅜ inches while in the case of the Indian Bee it is about 1⅛ inches. When artificial frames are used they are to be kept at the necessary distance from one another and this distancing or spacing is secured by tin frames called "metal ends" fitted to the projecting ends of top bars as illustrated in Figure 42. It can also be done by putting a nail at each end of the top bar of the frame. But the metal ends are very convenient and cheap. For correct spacing of the frames of combs in the case of the Italian Bee, every frame is provided with these metal ends (Fig. 43). For the Indian Bee the same metal ends will give the correct spacing when used in every other frame as shown in Figure 42. If the frames are correctly spaced in the hive and if the lower surfaces of the top bar are smeared with a little wax, the bees will build a straight comb in the frame. Smearing is done by melting the wax over fire and applying it with a brush or stick. The comb, in the middle in Figure 25, is such a one built by the Indian Bee. Proper distancing should be observed even when the frames are provided with sheets of comb-foundation. When comb foundation is supplied, the top bars of the frames need not be smeared with wax.

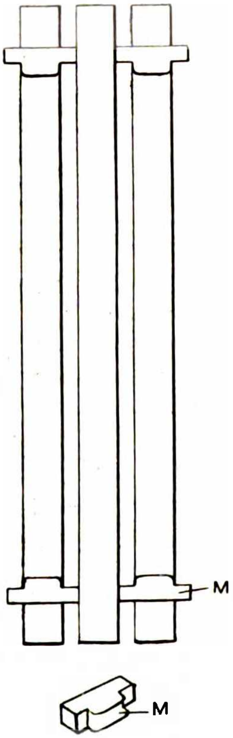

Fig. 42.—Spacing of frames for the Indian Bee. M—Metal end.

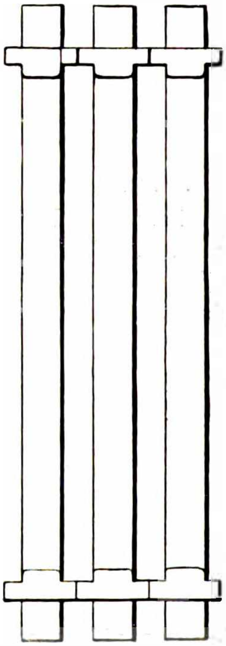

Fig 43.—Spacing of frames for the European Bees.

Use of Comb-Foundation.

The purpose of using the comb-foundation has already been explained (page 31). Either full sheets of foundation may be used as shown in Figure 28 or only a small strip as shown in Figure 44 to form the guide or starter for the comb which the bees are intended to build. The use of a full sheet of foundation has one advantage. The bees at once fill the entire frame with comb and combs with uniform worker-cells or drone-cells are obtained. When only a guide or starter is used the comb is built as in nature and is usually of the form illustrated in the middle in Figure 25 and many drone-cells may be formed in the lower part. The foundation is fitted into the groove on the under surface of the top bar of the frame.

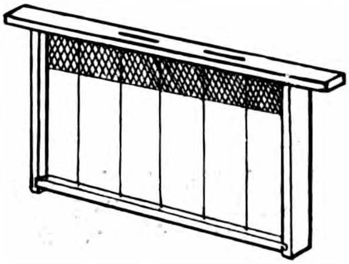
Fig. 44.—Frame with starter foundation.

Wiring Frames.

In order to strengthen the comb in the movable bar frame the frames are wired as shown in Figure 45. A thin copper or tinned wire is used.

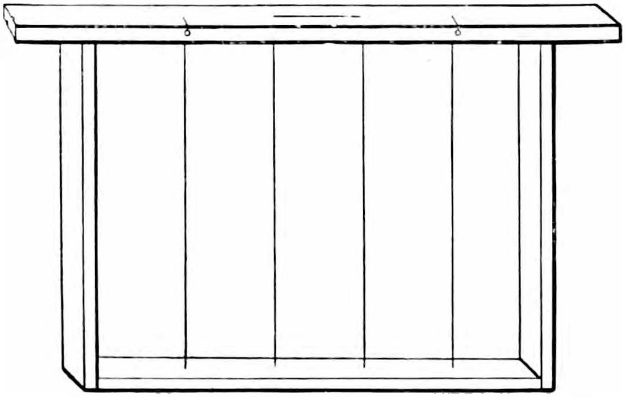
Fig. 45.—Frame wired.

A tinned wire is specially manufactured and sold for this purpose. The wire passes through the middle of the top and bottom bars of the frame, and of the comb when it is built. The comb is therefore held tightly in the frame and there is little risk of its breaking and falling off the frame in manipulation. After wiring the frame the foundation-sheet is fitted into it and the wire is embedded into the foundation by means of an embedder. Any round metallic disc can be converted into an embedder. A copper coin, a pice (Fig. 46) or half-pice does very well when a groove

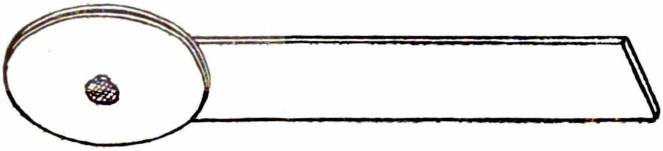

Fig. 46.—" Pice " wire-embedder.

is made all round the middle of the edge with a thin file. A hole is then made into the centre and the disc fitted on to a flat iron handle loosely so that it can revolve easily. Wire embedders are sold ready-made. One called the Spur Wire-embedder is illustrated in Fig. 47. There is a groove

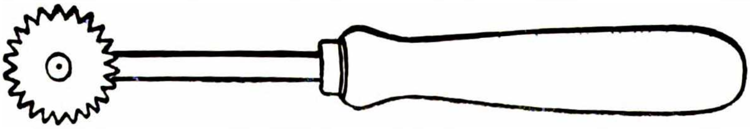

Fig. 47.—Spur wire-embedder.

in the spurs. The embedder is heated over a fire or flame and placed and run on the wire which fits into the groove (Fig. 48). The heat melts the

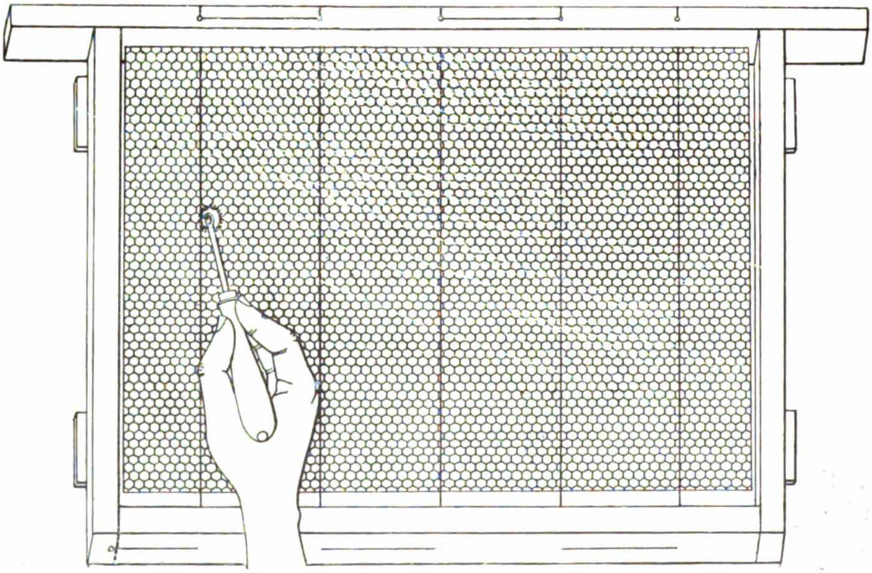

Fig. 48.—Embedding wire into foundation.

wax of the foundation. Therefore the wire gets into the sheet and is held in it when the wax cools down and solidifies.

In order to embed the wire into the foundation, the frame with the foundation is placed on a board (Fig. 49) ½ inch thick and of the size of the inside measurements of the frame.

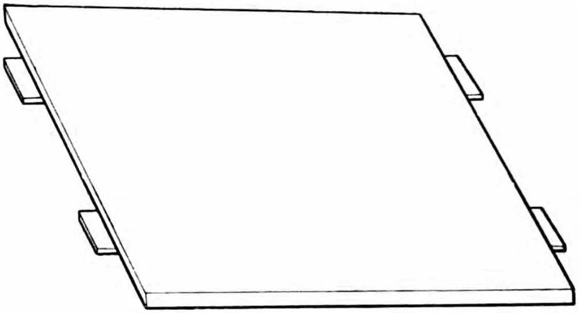

Fig. 49.—Wire-embedding board.

The Honey Knife.

The honey knife is shown in Figure 50. Both the edges as well as the tip are sharpened so that it cuts either way, and also by the tip. The handle is raised from the line of the cutting edge so that the knife can be worked flatly on a surface without the fingers of the holder interfering. Every bee-keeper should have at least two of such knives. They are easily made by local blacksmiths. This knife is useful for all kinds of work in connection with bee-keeping.

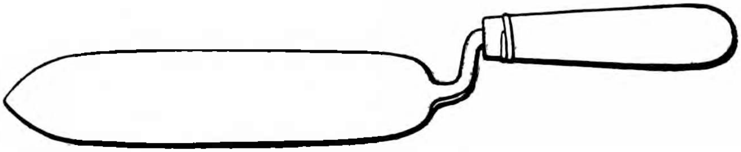

Fig. 50.—The honey knife.

Arrangement in the Hive.

The frames of combs are placed in the hive and a piece of thin gunny cloth, blanket or oil cloth (American cloth, the enamelled side downwards) of the size of the inside measurements of the hive, is placed over the frames so as to cover all the frames. This is called a quilt. Several folds of warm quilts may be necessary to keep the bees warm in the cold weather. In the hot weather only one sheet may be sufficient. Only so many combs are kept as can be covered by the bees. If the combs do not fill the entire hive, they are pushed towards the entrance and a wooden partition, called a division board or dummy (Fig. 51) is placed behind them, thus producing a chamber closed all round. The dummy is an ordinary wooden board about ½ inch thick, on the top of which a bar is fixed and the two projecting ends of this bar rest on the inner walls of the hive like the ends of the top bar of a frame.

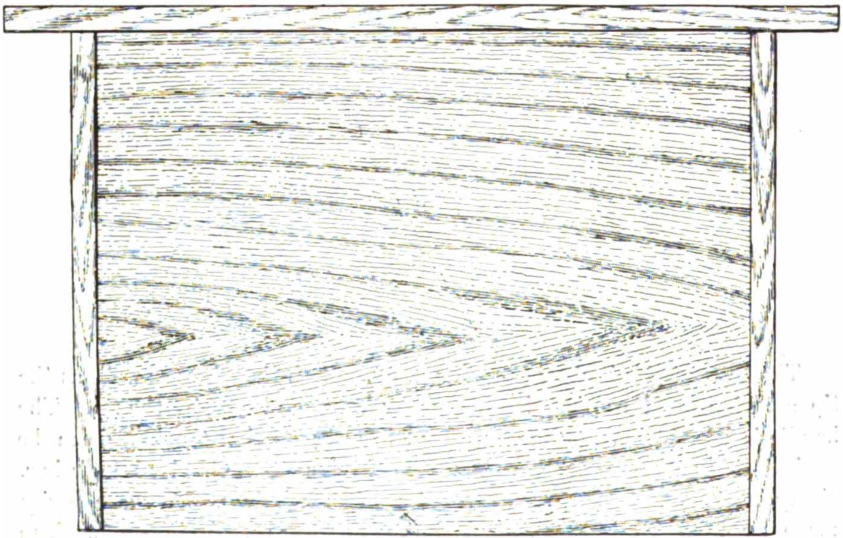

Fig. 51.—Dummy or division board.

Location.

In India vegetation is so common and rich that any place will probably be found suitable for keeping bees. The surest test is to find out whether bees occur in a wild state in the place and if they do, the place will surely be suitable. But whether the bees will yield large surpluses has to be found out by actually keeping a few colonies. It is always advisable to find this out before embarking on a large scheme.

As regards actual location of the bees, they should be placed where they will not be exposed to high winds and away from places which are much frequented by men or cattle. Provided there is proper ventilation in the hives and they are not painted black, there need not be any shade against the sun. When placed exposed to rain the roof should be so made or covered with tin that no water may get in. It is an advantage to place the hives so that they may get the morning sun. But in the swarming season it may be necessary to shade them. Hives can be placed under big shady trees and in villages, near the compound walls on the east side facing east. If a workable shed is built over them from the wall this will make a very good place for bees. The bees will get the morning sun, will be protected from the midday sun and rain as well as from high winds. The hives can be placed side by side at a distance of about 6 feet from each other. Wall hives should be on the east and south walls and should be at least about four feet apart. When a large number of hives are kept they can be arranged in rows about eight feet apart and one behind the other. The hives should be so arranged that they stand in between the hives in the succeeding and preceding rows.

Manipulating Bees.

The bee's sting.—It is the sting which deters people from approaching bees. The sting being barbed with backwardly directed teeth, it is held in the place where it is thrust. Not infrequently a portion of the entrails of the bee is also left behind. The bee which is thus deprived of its sting dies afterwards. At the base of the sting there is a minute bag, called poison-bag containing a fluid which causes the irritation and swelling which follow a sting. When a sting is received the part should not be rubbed as is usually done. The sting should be pushed out with the edge of a knife or finger nail by applying the knife or nail at the side. The sting should not be pressed as in that case the poison bag bursts and its contents get into the part stung. If the sting is removed without injuring the poison-bag, there will not be much irritation or swelling. Several repeated applications of benzene or liquid ammonia will prevent much irritation and swelling. If the swelling is large and painful fomentation with hot water will afford relief. When a person is stung several times he becomes in a way inoculated with the poison and gradually becomes less subject to the evil effects of the sting.

If the bees are handled confidently without fear and very slowly without any sharp quick movements or jarring, they are not at all likely to be irritated and to sting.

Gloves and Veil.—When angry the bees at once fly at the face. Therefore it is always safe to use a veil, as shown in Figures. 57 and 58. It is used over a hat or a big turban so that bees may not be able to reach the skin with their sting even when they sit on the veil. In place of the costly hat or turban, a simple thing can be had made by *doms* (basket-makers) for about half an anna or so. This is shown in Figure 52 and is used in many districts by labourers as a protection of the head against sun. In some places it is known as *matla.* Its use with a veil is shown in Figure 58. The veil is made by sewing a piece of mosquito netting and the portion in front of the eyes should be dyed black for distinct vision. The other parts exposed to the sting are the hands which can be protected by gloves. (Fig. 57.) But it is very awkward to work with gloves on and they can be and are safely discarded after some time when confidence is gained. Provided the body is covered it does not matter what dress is used. (But bees do not like black objects and it is better to wear light-coloured clothes when dealing with bees.—T. B. F.).

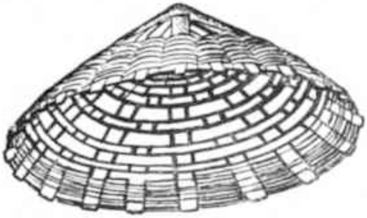
Fig. 52.—"Matla."

Subduing Bees.—Bees have a dislike for, and are rather frightened at, smoke and any strong odour such as that of carbolic acid. Therefore they are subdued when exposed to smoke or carbolic acid fumes, remain quiet and can be handled easily. When the bees are frightened they gorge themselves with honey and when filled with honey they show hardly any inclination to sting.

Smoke of burning rags or wood may be blown on them. Tobacco smoke is rather too strong. For smoking bees, a special and very convenient smoker is manufactured and sold. (Fig. 53.) It has a cylindrical tin fire-box with a detachable nozzle and a pair of bellows fixed

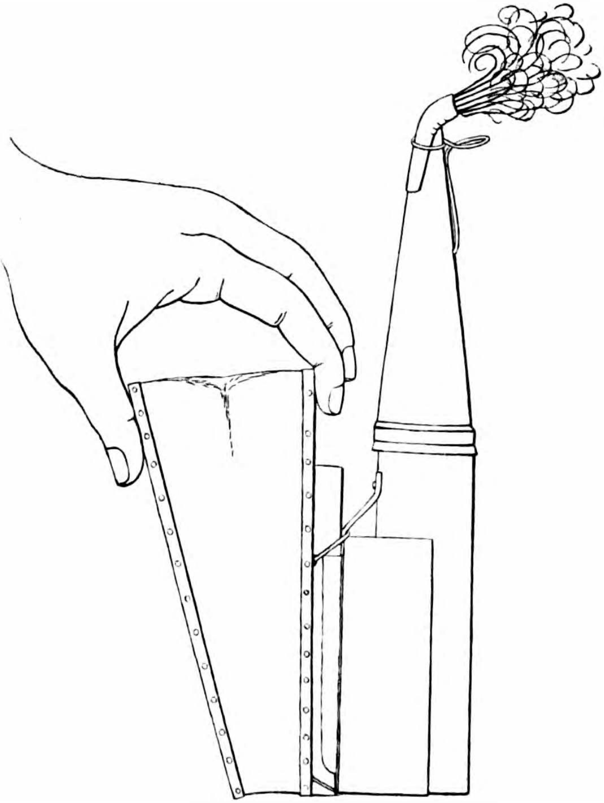

Fig. 53.—The Bingham Smoker.

to it. Rags or pieces of wood are put in the fire-box and lighted and the bellows worked with hand. The smoke comes out through the nozzle and can be directed in any direction.

Carbolic acid is used in solution in water. One part of carbolic acid and two parts of water are mixed and well shaken. A piece of cloth is dipped in this solution and the water wrung out. When this cloth is presented the smell of carbolic acid causes the bees to recede quickly.

Precautions in manipulation.—Open the hive slowly, with slow movements and without producing any jarring. Take out and replace combs similarly. Avoid quick movements of hand, body or appliances used. Avoid crushing a bee. The smell of a crushed bee irritates the others very much. Similarly the smell of a sting irritates them. If a sting has been received, and stings are frequently received on the gloves in bad manipulation, it is better to walk away slowly to a little distance. Then remove the sting and blow a little smoke on the part stung to hide the smell.

How to procure Bees and make a Start.

Italian bees are not available in India and even when they will be available they will have to be purchased. Colonies of the Indian Bee are easily procurable in the swarming and migrating seasons. The swarming season is in spring in the Plains and in the Hills once in September-October and again in March-April. To places near the Hills bees migrate in late winter and early spring. Similarly they migrate to the Hills in early autumn. They can be secured in three ways :— (1) by using decoy hives, (2) by capturing swarms and hiving them and (3) by hunting out and hiving colonies which have already settled in cavities of tree trunks or walls or in the ground or in unused boxes.

(1) Decoy hives are ordinary hives so arranged and placed that swarms come and occupy them. Six frames fitted up with metal ends and starters of foundation are placed in the hive with a dummy behind, and covered with quilts. The hive thus fitted is placed in a sunny situation, preferably shaded at midday, for instance, under a big tree or by the side of a wall. In the Plains decoy hives should be placed out early in January and in the Hills in September and March. Occasionally the hives should be visited to see if bees have come and occupied them and that the frames have not been displaced. If the frames are not properly distanced combs will be built across them, cementing them together.

(2) If a look-out be kept for bees in the swarming and migrating seasons, stray swarms will be found to settle in bamboos and bushes and sometimes on open places such as a branch or trunk of a tree or a wall. They should be looked for from midday till late in the afternoon. When a swarm has settled in an accessible place it can be captured in the following manner. Take a small wooden box about 8″ × 8″ and about 6″ deep. A smaller box may do if the swarm is small. One side should be open and the wood or at least the inside of the box should be rough and unpolished. Have smoke ready in the smoker. Then hold the box open side down just over the cluster of bees or rather touching the cluster. Now apply a little smoke to the bees from below. Much smoke should not be used. The bees will slowly crawl into the box. The box should not be moved while they are crawling into it. When all have got into it, it can be slowly removed but should not be turned over and should be held open side down as it was

presented to the bees. In this manner the swarm may be carried to any distance, provided all quick and jarring movements are avoided. It is better to cover the open side of the box with a piece of cloth while carrying the bees. Before trying to drive the swarm into the box in order to quiet the bees, sugar syrup may be sprinkled on them (not poured in large quantities). After waiting for a little while during which the bees will lick up the syrup and clean each other's bodies, the swarm can be driven into the box in the manner described. A swarm which has just emerged from a hive need not be treated to syrup as the bees fill themselves with honey just before issuing from the hive. On arriving at the place where the hive is to be kept, get a hive ready as described in (1), but putting in addition one or two combs filled with sugar syrup. (See page 57 on "Feeding.") The combs of sugar syrup should be placed near the entrance. If no empty combs are available the sugar syrup should be placed in a "feeder" above the quilt. The box with the bees may now be placed inside the hive, its open end turned towards the frames and touching the nearest one. The hive is now covered with the quilt and roof, and left. The bees will leave the box and occupy the frames. The box can be removed the next day and the frames closed up with the dummy. A newly-hived swarm should always be fed for some days. Then they are not likely to abscond and will build the combs very quickly. As a further inducement to stay, if there are other colonies going on, a comb with unsealed brood may be placed in the hive. The grubs will be taken care of by the bees which have an affection for nurselings, and they will not be left in an uncared-for state. The comb of brood should be placed near the box containing the swarm. If the box into which the swarm has been driven is too big to be accommodated in the hive, a gap may be produced in the hive by moving two or three frames towards the back and the whole swarm jerked into this gap by a sharp quick movement and the frames and dummy drawn forward and the hive at once closed with quilt and cover.

Sometimes the swarm settles at a place where it is not convenient to use box and smoke in the manner described. If it has settled on a branch the box may be held with the open side up just under it and the branch suddenly struck with a thick stick with such force as to dislodge the whole swarm into the box. The box is at once covered with a plank or cloth and turned upside down. The cluster will soon settle in the box and can then be hived. A wide-mouthed cloth bag can be used to catch a swarm which has settled on the branch of a tree. The open mouth can be passed up from below and closed over the cluster. The bees are carried to the hive and poured over the frames. If the mouth of the bag be not raised free from the frames the bees will not be able to fly.

When a swarm settles on a high inaccessible branch, a cloth bag can be used in the following manner. Its mouth is sewn round a loop of bamboo branch and the loop tied to the end of a pole. (Fig. 54.) The loop is raised and made to touch the branch enclosing the swarm and then quickly drawn towards one side disengaging the swarm into the bag and the bag quickly turned edgewise preventing the bees from escaping.

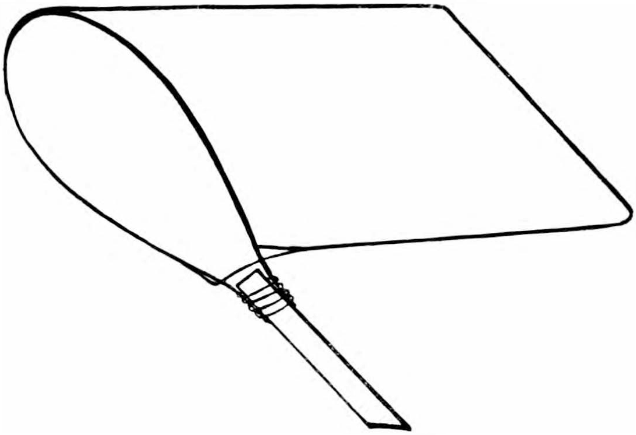

Fig. 54.—Swarm catching bag.

General directions for capturing and hiving swarms are given above. On these principles judgment may be used as to how best it can be done by varying the conditions a little.

Sometimes when a swarm settles on a branch which can easily be cut, it can be carried home on the branch and hived directly. For this purpose the bees require to be gorged by continuing sprinkling them with sugar syrup for some time.

If use is made of bar-frame hives in which the body box is capable of being removed from the floor-board, swarms can be hived in the following manner, which is, however, not quite suitable for the Indian Bee, but does well for the Italian Bee :—The front of the body box is slightly tilted up from the floor-board so as to present an entrance along the whole breadth of the hive. A plank or piece of cardboard is held just over the alighting board so that when the bees are poured on the board they can easily enter the hive. By a judicious application of smoke the bees can be made to enter the hive. Some of them may be pushed gently with the hand into the hive and the others will follow.

(3) When a colony has already settled and built combs in a place, the combs are cut out along the line of attachment and fixed into frames. For this purpose a comb-fixer is made with a stiff wire, as shown in Figure 55, by bending the ends of the wire at right angles and soldering cross pins to its body. Two of such wire-comb-fixers are fastened to each frame as shown in Figure 56. A comb is cut out and fastened into cross-pins of comb-fixers, so that its upper edge touches the under-surface of the upper bar of the frame. If the upper edge of the comb is not straight, it can be levelled by cutting off a portion and then fixed into the frame. The bees soon fasten the comb to the lower surface of the upper bar of the frame with wax and the wire-comb-fixers can afterwards be removed.

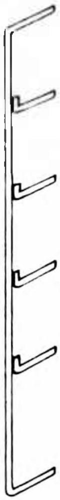
Fig. 55
Wire comb-fixer.

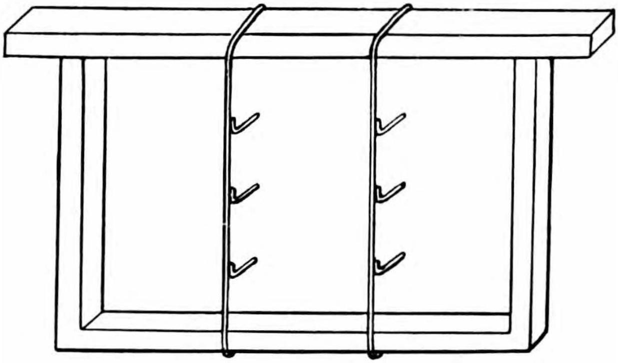
Fig. 56.—Frame fitted with wire comb-fixers.

When a colony has built combs in the cavity of a tree-trunk or wall, in the middle of a bright day when bees are flying freely, a wide opening is made so that the combs may be cut out with the hands. Before this is done a hive is got ready as in (1) but without any starter of foundation in the frames which are now fitted with the wire comb-fixers. The bees are plentifully smoked before the operation is commenced. After the opening is made, by blowing smoke on them they can be made to leave the combs which can then be cut out one by one and fixed into frames and placed in the hive. The bees will cluster away from the combs. If there be space and convenience they can be driven into a box as in (2) and put in the hive. If this is not convenient the cluster can be scooped up with a bowl which is at once closed with a piece of plank and then inverted over the frames in the hive, the covering being slowly removed. The bees will crawl down and occupy the combs. The hive is now covered with its quilt and roof. The queen is sure to be brought into the hive with the cluster in this way. Some bees will remain inside the cavity. They can be smoked out or swept out with a feather. The cavity is now closed with mud entirely and the hive so placed that its entrance be near where the entrance of the cavity had been. The hive is left there till it is dark. The flying bees will enter it in time. The hive can be carried in the dark and placed in the permanent situation.

The transferring can also be done in the evening after darkness has set in. In the middle of the day many bees take wing and hover round the operator. At night the bees do not fly and therefore can be managed better. If it be not inconvenient the transferring is better done in darkness, of course use being made of light which is kept at some distance.

In the same way, bees from a log or box or pottery hives can be easily transferred into bar-frame hives. This is always better done in the middle of a bright day when bees are flying freely. For transferring from a log hive a sort of a box is necessary with one open side which will fit the opening on either end of the hive. First of all smoke is driven into the hive through one end and the hive removed to a little distance, the new frame hive being placed in its position. The log hive is turned over, tilted up a little and stood in a somewhat inclined position so that the combs attain a reversed position. Put in a little more smoke. After a little while place the box at the upper end which is now opened, and beat the sides of the log with two sticks. The bees will leave the combs and move upwards into the box and cluster in it. The cluster may be kept aside a little. The log hive is opened, the combs cut and fitted into frames by means of wire-comb-fixers and placed in the frame hive. The bees are then put in and the hive covered up with quilt and cover.

PLATE VIII.

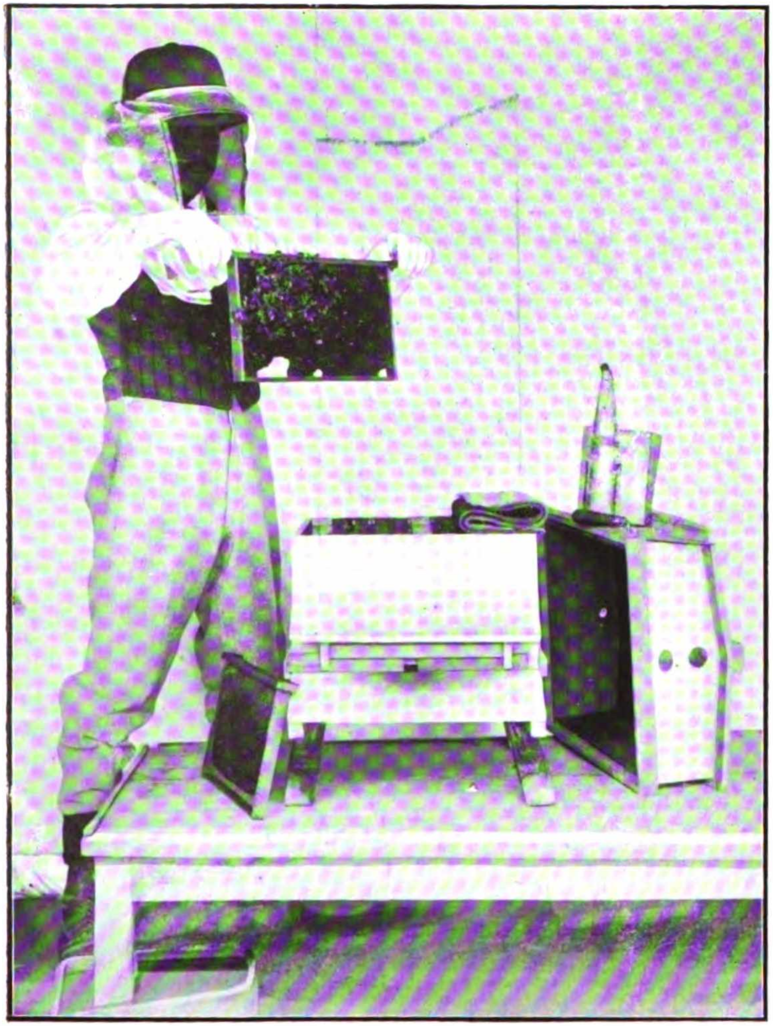

Fig. 57.—Examining a hive

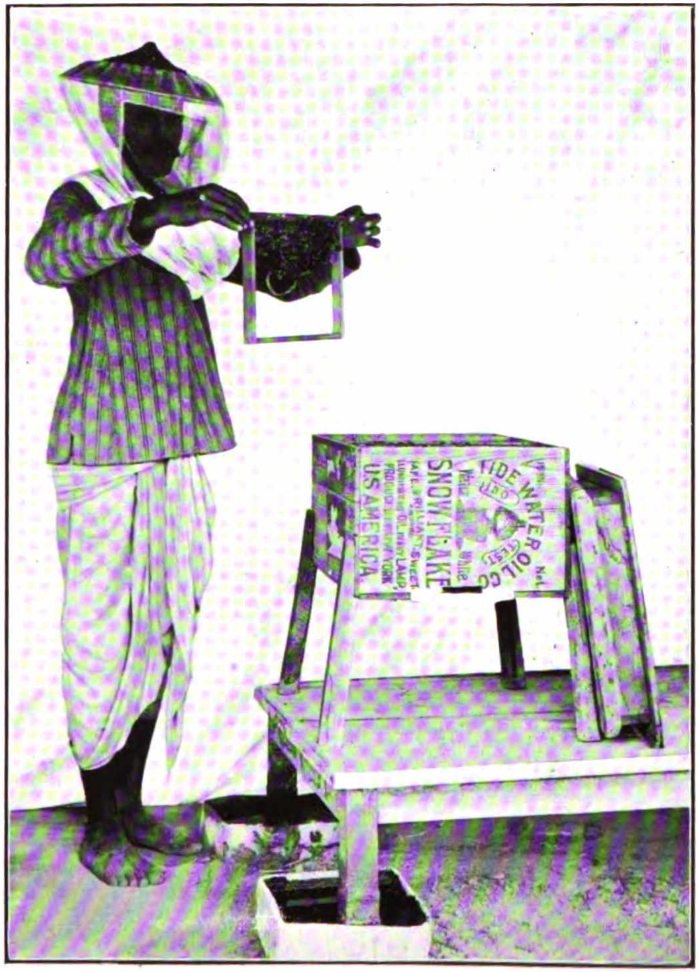

Fig. 58.—Examining a hive.

Similarly bees from a box hive may be transferred by taking away the bottom of the box, turning the box upside down and placing another box on it.

Transferring from a box can be done in another way. The bees build the combs on the under-surface of the upper-side of the box. This side of the box can be slowly removed with the combs and bees and placed over the empty (without any frames) frame-hive which is now stood in the position of the old box. By the application of smoke, bees can be made to recede from the end comb which is cut out, fixed into a frame and placed in the hive at the other end. In this way all the combs can be removed one by one, fixed into frames and placed in the hive. The bees as they recede from the combs which are being cut out, crawl on to the combs which have already been fixed into frames. After all the combs are thus removed the original plank is removed and the hive covered up with quilt and cover.

By varying the devices and using a little judgment all colonies, in whatever position they may be, can be transferred into bar-frame hives.

When a colony of bees is purchased in a bar-frame hive, all that is required is to transfer the frames of combs with bees from the travelling box into a proper hive. Those which may adhere to the sides of the travelling box may be jerked down on the frames or in front of the hive.

Examining a Hive.

The best time to examine a hive is any time on a bright day when bees are flying freely. Hives should not be opened on chill windy days. Rainy days should also be avoided. Special care is to be taken to see that the brood is not chilled. If chilled, the brood dies.

Figures 57 and 58 show a hive being examined. First of all take away the roof. Then puff in a little smoke by raising the blanket and replace the blanket and wait for two or three minutes. Now roll away the blanket from one end. Frequently the frames are gummed to each other and to the hive with propolis. Loosen them by slowly pushing the edge of the knife between the metal ends. If the hive is full of combs the end one is taken out, examined and stood on the ground, leaning on the hive. The other combs are taken out one by one, examined and replaced in the hive. In examining a comb it is taken out by holding the two ends. One side is easily visible. The other side is brought into view through the various manipulations shown in Figure 59. A comb should never be held in a horizontal position, as when full of honey and brood it may break away. Position 1 in this figure is as it is taken out of the hive. Position 2 is obtained by raising one end. Then it is turned round (position 3) and the other side is in view. In order to be able to examine minutely the raised end is now lowered (position 4). By reversing the movements in order the comb is brought into the normal position and replaced in the hive. After examination all the combs and quilts are properly replaced and the hive covered.

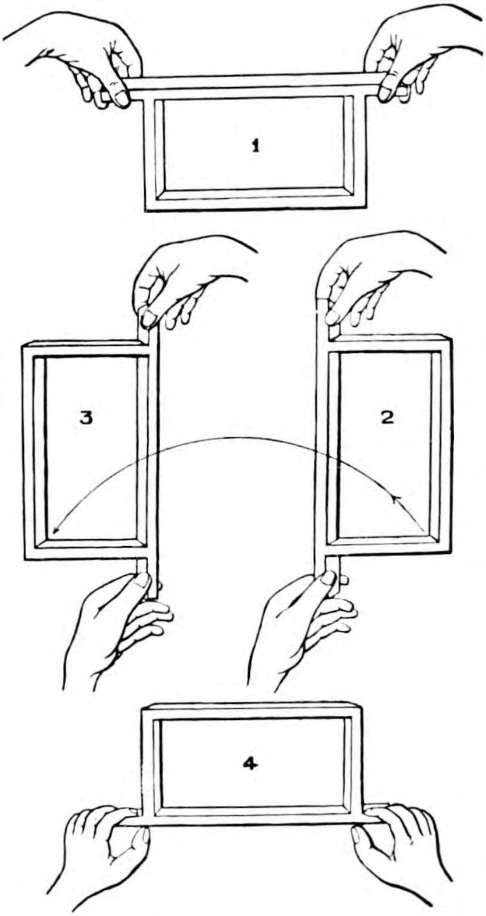

Fig. 59.—Manipulating a comb.

Moving Bees.

Bees fly to a distance of about two miles or more all round from the hive and come back without fail. They take a careful note of the surroundings and remember the exact location of the hive. If the hive is removed the flying bees will come back to the place where it was standing and will hover in the air. They will fly round and round where the entrance of the removed hive had been and will ultimately drop down exhausted and die. If it is necessary to move a hive from one part of the apiary to another, it should be done gradually by about two feet and certainly never more than three feet every day. The moving should be done only at night after dusk when all bees have returned home. No moving should be done on any day on which the bees do not fly. In order further to make the bees note the changed surroundings some straw or grass may be thrown in front of the hive or a board like a signboard pitched in the front on one side. If however, it is intended to move a hive to a distance and to completely foreign surroundings it can be done on any day at night. If the hive is removed at once to a distance of two miles or more, not a single bee will be lost. If the distance is less than two miles, some bees while flying may get into the old run and return to the old location and thus be lost. The loss thus incurred is not however considerable and does not usually affect the population and strength of the hive especially if the new surroundings are quite different from and in contrast to the old. All take a note of the new surroundings and remember them, except probably some old bees.

Work of the Bees.

The routine work inside the hive may continue at night but outside fieldwork is done only during the day-time. All the bees of the colony return to the hive at dusk and stay in the hive at night. Bees fly most during the morning, less when it is hot in midday and again more in the afternoon. (N. B. Occasionally *Apis indica* comes in to light at night and perhaps occasionally these bees fly at night. T. B. F.) All return to the hive at dusk and remain there the whole of the night. They do not fly when it rains or when it is very cold and chilly or foggy.

Management.

The bees are kept in the hive well covered with one or more quilts to keep them warm. In the cold weather several folds of blanket may be necessary. In the hot weather a single piece of gunny cloth is enough.

The frames of the combs are kept at proper distances by means of the spacers. If they are left further apart extra combs may be built in the extra space. If the distance is less two frames may be joined by cross combs. The combs should be straight. If a comb is bent it should be straightened by pressure with hand and if this is not possible the bulging portion should be cut off. There should not be more combs in the hive than can be covered by the bees. The extra combs may be stored in properly closed boxes and given to the bees when necessary. All the combs should be pushed towards the entrance and if an open space is left inside the hive, the combs should be enclosed with a dummy behind.

Ordinarily the hive need not be opened every day for examining the bees. It is enough if it is opened and examined every 10 or 12 days to see (1) that the queen is there and laying eggs. It is not necessary to see the queen actually. If there are eggs and young brood, it can safely be taken for granted that she is alive and active; (2) that there is food for the bees, in the shape of sealed or unsealed honey; (3) that all the combs are covered by the bees; if not, take out the extra combs; (4) that Wax Moth or any other enemy has not got in. Combs which are not covered by the bees may be infested by the Wax Moth caterpillar. In the hive of the Indian Bee frequently debris collects on the bottom consisting of broken pieces of cappings, etc. Wax Moth caterpillars are frequently found present in this debris even though the combs are uninfested. Their presence is indicated by the webbing of wax and other particles into tubes. The debris should be cleared out, the caterpillars, if any present, should be killed, either cut with a knife or crushed under foot.

But a visit should be paid every day to the hive for a few minutes only. By a little experience the bee-keeper will find out whether matters with the bees are all correct or not, by simply looking at their behaviour. A visit in the morning will help to diagnose the condition of the colony almost as accurately as actual examination. On all bright days the bees should do field work, flying out and bringing in loads of pollen. The amount of field work varies according to season, more work being done in the season of honey-flow than at other times. If instead of working as usual the bees are found flying in front and round the hive as if seeking something, or listlessly sitting and hanging about the alighting board, there may be something wrong and an examination may be necessary.

The bees do little work in the rainy season as they find little forage outside. If no food is left in the hive, it may be necessary to feed them. Also they do hardly any work when it is very cold and at this time too they may require food. (See "Feeding" below.) When forage is short, breeding is carried on at a very slow rate, the queen laying a small number of eggs and a small number of bees being reared. After the rainy season is over, breeding is resumed at an accelerated rate and it may be necessary to provide more combs in order to provide the queen with more laying space. The population of the colony will increase. When the combs in the hive are all covered by bees and filled with honey, brood and eggs, fresh combs can safely be added, being placed in the middle. By gradually providing more space the population of the colony should be increased as much as possible. The more populous a colony in the honey season the more honey it will gather, yielding greater surplus. When combs are not available, frames with full sheets of foundation should be supplied and combs will be built on them. It is only in the honey-flow season that combs can be got built by the bees. In the Hills the more important honey-flow occurs in October-November and the bees will gather enough honey to yield a surplus. In the Plains at this time there is a short minor honey-flow; the bees gather a little honey but not enough to yield a surplus. The main honey-flow occurs in the spring in the Plains and a second honey-flow at this time in the Hills, surplus honey being obtained in both localities. The surplus honey is taken out by the bee-keeper and represents his profits. The method of taking out the honey or "extracting" as it is called is described below on page 69. The bees continue to get some honey till the end of May or even the middle of June, but of course in less quantities than in spring. Breeding is also carried on at a maximum rate in the honey-flow season and decreases gradually. At this time the bees do not require so many combs in the hive. Therefore the surplus combs should be taken out and stored for use later on. If enough honey is left in the hive to serve as food for the bees till forage is available in the autumn, they will not require much attention.

Unless there be a source of water near the place where bees are kept, say, a pond or spring, water should be provided in a vessel which should be kept in a cool shaded place and it should be changed very often.

Feeding.

Bees do not require to be fed always, as they gather their own food, *viz.*, honey and pollen from plants so long as they are available. Even when honey and pollen become scarce in the fields it is not necessary to feed them so long as there is a store of these substances in the hive. Honey is the principal food of the adult bees and if there be no honey in the hive they will starve and it becomes necessary to supply food to prevent them from starving, in the shape of honey or honey diluted with water or sugarcandy or sugar syrup. The feeding thus given may be called "starvation feeding." A starving colony may desert the hive and abscond. Pollen is the principal food of grubs and without pollen brood-rearing is not possible. Usually bees gather pollen even when the plants are not secreting nectar and it can be easily found out whether any pollen is being gathered by standing in front of the hive and watching the bees which are returning from the fields. Loads of pollen on the thighs of hind legs of returning bees are easily distinguishable. If no pollen is being brought in, and there be no store of pollen in the hive, it becomes necessary to supply a substance which may serve for pollen, so that brood-rearing may not be stopped. Any of the following can be used as a substitute for pollen, *viz.*, ground whole kernels of oats, corn and wheat, cotton seed meal, pea meal, wheat flour, rye flour, bean meal and barley meal. The common practice is to use rye meal or pea meal. The substitute has to be scattered on a board or on clean dustless ground in a cool shaded place near the hive and protected from rain. In India, at least in the Plains, bees gather pollen throughout the year, but get very little honey in the rainy season. Brood-rearing is not carried on satisfactorily on a large scale unless the bees get honey from outside sources, though there may be sufficient store in the hive itself. Therefore in the rainy season brood-rearing is at an ebb and all the pollen that is gathered is not used. For this reason a large quantity of pollen is found stored in the combs at this time. Food may be supplied to accelerate breeding and this is called "stimulative feeding."

As a rule it is better to do away with the necessity of feeding bees at any time. If after the honey-flow is over enough food is left in the hive it will not be necessary to feed the bees in the time of scarcity in the rainy season. A little stimulative feeding can be practised with profit in special circumstances. To take a concrete example, at Pusa a short minor honey-flow occurs just after the rains at the end of September or early in October. Breeding is accelerated by the bees at this time. Breeding is again retarded when this flow is over and resumed on a large scale by the middle or end of January when the main honey-flow commences. A little stimulative feeding may be given when the minor flow is over so that brood-rearing may be continued unchecked. This will be profitable because when the main honey-flow commences there will be a large body of workers ready to gather the honey as soon as it is available.

Discrimination should be used in supplying food, and when to supply it, has to be determined by the bee-keeper by examining the condition of the colony.

(1) Starvation food should not be supplied in large quantities, *i.e.*, approximately not more than what is required. If more is supplied all

combs will be filled with the surplus, leaving no room for the queen to lay eggs. Therefore brood-rearing may be seriously interfered with. Whether more is being supplied than necessary can be found out by examining the combs. If a large quantity is being stored the supply should be decreased.

(2) For stimulative feeding too the above applies. In addition stimulative feeding hardly serves the purpose when the colony is very weak in population and when the queen has ceased to be prolific. It serves the purpose well when the colony is fairly populous and possesses a prolific queen. Therefore if it is intended to apply stimulative feeding to a very weak colony, care should be taken to increase its population by the addition of sealed brood or bees from other colonies.

Food and how to give it.

The best food is honey. If there is capped honey in any comb, the capping may be scratched and the comb placed in the hive. The bees will utilize the honey. If there be any capped honey in the hive, the capping may be similarly scratched.

Extracted honey can be supplied diluted with water in the proportion of half water and half honey and warmed a little. Good cane sugar dissolved in water in the proportion of 1 lb. sugar in 1 pint water and warmed a little serves the purpose equally well. Fermented honey should not be fed, nor any honey of which the source is not known; because it my contain disease germs. If any purchased honey is used the solution should be boiled for about half an hour and should then be supplied when cooled. The liquid food is poured into an empty comb which is then placed in the hive.

Various kinds of feeders, *i.e.*, vessels in which to supply food, have been devised. Use of empty combs is the best as it places the food at once within the reach of the bees. Any flat bowl or tin pot can be used as feeder. The food is placed in the pot and some straw or sticks floated on the food so that the bees may find resting place or they get drowned in the food and die. The pot is placed on the frames. If its sides are smooth, some straw or sticks may be placed in a slanting position both inside and outside the pot so that the bees may easily walk over these supports and reach the food. A satisfactory feeder is made with a wide-mouthed bottle or glass or tin can. It is filled with food and its mouth tied with a piece of cloth as shown in Figure 60a. It is quickly inverted and placed on the frames mouth downwards. The bees suck out the food through the cloth. This does very well for stimulative feeding. In order further to secure and steady it on the frames a block of wood (Fig. 60 b) may be used, in which a hole is made to fit the mouth of the bottle. A very satisfactory feeder is made with a jam bottle having a screw top tin cover. A few big holes are cut in the tin cover. The bottle is filled with syrup, the cover put on and a piece of cloth tied over it. It is similarly placed inverted in a wooden block on the frames inside the hive. (Fig. 61.) When it is very cold and it is not advisable to remove the blanket, a hole may be cut in the blanket and the block of wood placed over this hole so that bees can take the food down without allowing any cold air into the hive.

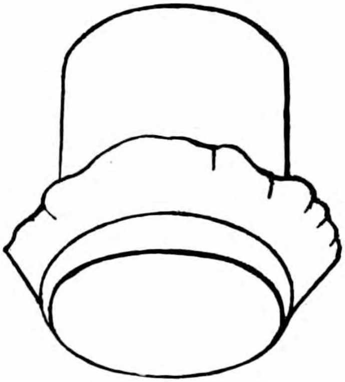

Fig. 60 a.—Tin can feeder.

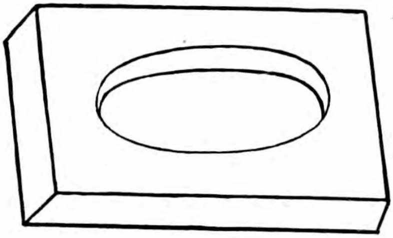

Fig. 60 b.—Wooden block for feeder.

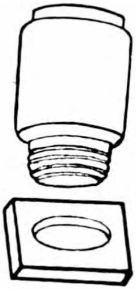

Fig. 61.
Bottle-feeder.

Robbing.

In times of scarcity when no honey is available from plants, bees try to rob each other. Usually weaker colonies are robbed by stronger ones. The bees force their way into the hive they rob, take the honey and store it in their own hive.

The surest preventive of robbing is to keep all colonies strong and to keep them provided with food. Starving bees make desperate attempts at entering other hives even though they may die in their attempt.

Robbing is excited if honey is allowed to be spilt or to remain exposed near the hives. Bees get into the bad habit of robbing when they get honey so easily. In times of plenty they do not mind honey thus left exposed. For this reason in times of scarcity hives should be opened and closed as quickly as possible. It may be advisable to do away with the necessity of opening hives at all at this time. The smell of the honey in it may induce robbing. For the same reason it is advisable to supply food at dusk when bees have stopped flying, if any colony requires to be fed at all. In times of scarcity the entrance hole should be diminished so that bees may be better able to guard it against robbers.

The Indian Bee is specially prone to robbing when in want of food and if Italian bees are kept, it will be found always making desperate attempts at entering the hives of Italian bees in the rainy season and up to September.

How to take the Surplus Honey.

The surplus honey is taken in two ways. (1) It is allowed to be stored in ordinary combs and then extracted by means of an extractor as described below. The honey thus secured is called "extracted" honey. (2) The other method is to make the bees build small combs in special small frames, called "sections" (Fig. 62) and store the surplus honey in these small combs. When the honey is capped, the section with the comb is sold, being enclosed in a glass case. The honey thus secured is known as "section" or more commonly "comb" honey.

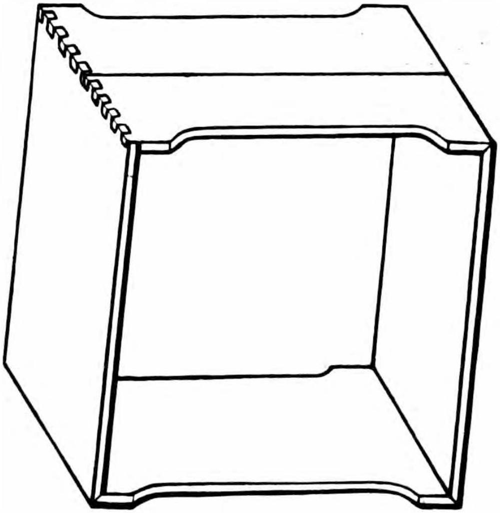

Fig. 62.—Section for comb honey.

It is more difficult to secure comb honey from the bees and comb honey cannot be produced unless the honey-flow is very rich and the bees are good gatherers. It is no use trying to secure comb honey from the Indian Bee. Even with the Italian Bee, the beginner is recommended to take only extracted honey.

Surplus honey from the Indian Bee.—As stated above only extracted honey should be taken from this bee. All that is necessary is a queen excluder dummy (Fig. 63) which is placed between the combs in order to partition off some of the combs from the queen. The queen having no access to them there will be no eggs laid in them and consequently no brood. Combs containing both honey and brood can be placed beyond the queen-excluder and when the bees have emerged the honey can be extracted.

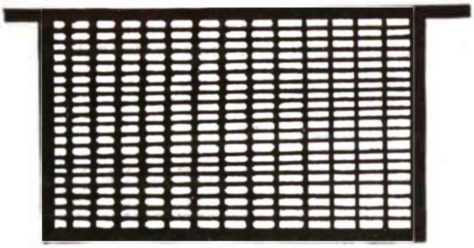

Fig. 63.—Queen-excluder dummy.

The kerosene-box hive is capable of accommodating 14 combs and the standard hive 12 combs for the Indian Bee. These combs are more than sufficient for a strong colony of this bee and in fact when it has attained to this strength, it is very likely to send out a swarm. Some of these combs are partitioned off with a queen-excluder dummy for storing honey to be extracted. No separate chamber or box is necessary for accommodating combs for surplus honey. In exceptional cases when it is necessary to find more accommodation, this can be done by adding another box above the hive in the manner described for the Italian Bee below.

Surplus honey from Italian or any variety of the European Bee.—Both extracted and comb honey can be secured from these bees. For extracted honey a box of the same construction as the body box of the hive but without the entrance hole, is placed above the body-box as shown in Figure 64.

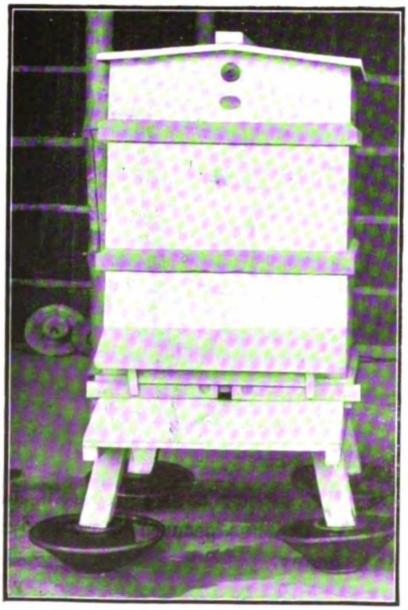

Fig. 64.—Hive with super on. Note how the size of entrance hole can be regulated by inserting two pieces of wood.

Figure 65 shows the parts of the same. A layer of combs is placed in the second box in the same way as in the body-box. This second box is known as a "super" or "doubling box." More than one super can be used, one above another, when large quantities of honey are being gathered. In order to prevent the queen from getting to the combs in the super and laying eggs in them, a queen-excluder zinc sheet is placed between the body-box and the super.

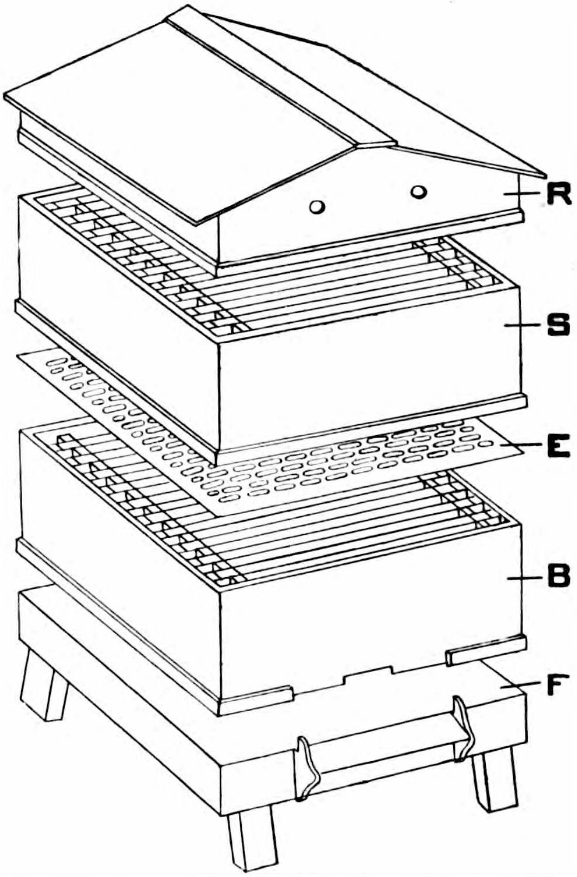

Fig. 65.—Hive fitted with super for extracted honey ; parts shown separately.
F.—Floor board.
B.—Body box.
E.—Queen-excluder sheet.
S.—Super.
R.—Roof.

For comb honey, sections are required. They are sold in the form of flat pieces as shown in Figure 66 which is folded into the section shown in Figure 62. There is a slit at the upper side of the folded section into which is fitted a piece of thin comb foundation, specially manufactured for use in supers and hence called "super foundation," the foundation used in ordinary frames being distinguished as "brood foundation." The sections are arranged in a box, called a "Section Rack" (Figs. 67 and 68) open both at bottom and top and with only bars at the bottom for supporting the sections. A thin wooden or tin partition, called a "Divider" is used between the sections so that combs may be built separately in each. The sections are held tightly in the Rack by means of wooden boards and springs.

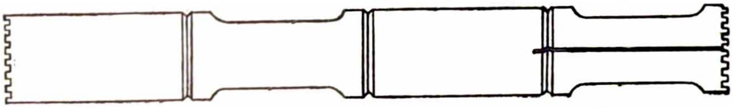

Fig. 66.—Section unfolded.

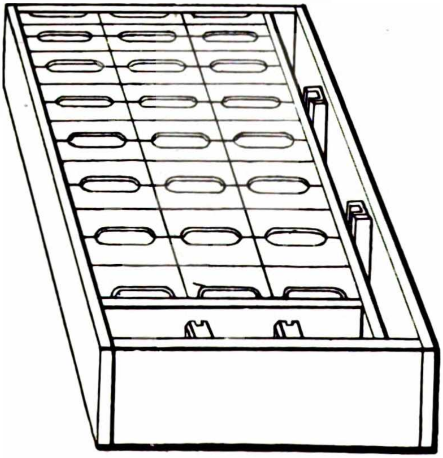

Fig. 67.—Section rack with sections arranged.

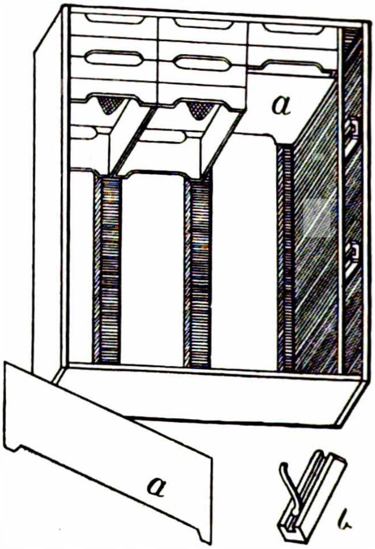

Fig. 68.—Section rack to show how sections are arranged.
(*a*) Tin divider. (*b*) Spring.

The Section Rack is placed inside a super as shown in Figure 69 with a queen-excluder sheet below. In supers for accommodating Section Racks, the inside walls are dispensed with.

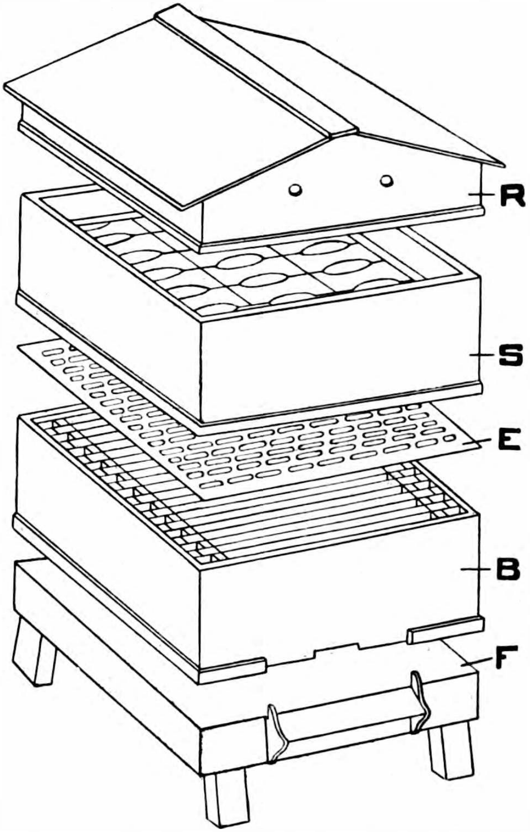

Fig. 69.—Hive with super arranged for comb honey ; parts shown separately. S.—Super with section rack in place. Other letters as in Figure 65.

The upper chambers of the wall hive, which has been recommended to be made according to the measurements given, are for use as supers which can be utilized both for extracted and comb honey.

When the combs in the sections are filled with honey and capped and before the Rack is taken off, the bees are cleared off by using what is known as a Super-clearer (Fig. 70). It is a flat board of the size of the bottom of the Rack and having in the middle a spring Bee-escape (Fig. 71) which allows bees to come out of the super but not to go back into it.

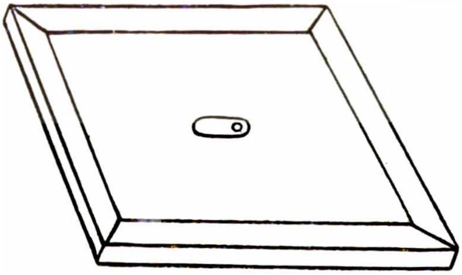

Fig. 70.—Super clearer.

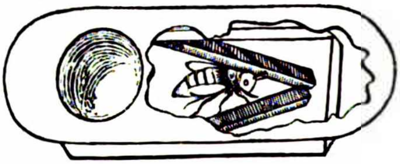

Fig. 71.—" Porter " spring bee-escape.

The Honey Extractor.

The Honey Extractor is a machine in which combs are rapidly revolved in such a way that the honey is thrown out of the cells and received in a vessel. The principle on which it works is this. If a weight is tied to the end of a string and rapidly whirled, there is a pull on the string and if the hold of the string is let go, the weight will fly off to a distance. This force is known as centrifugal force as the weight flies away from the centre of revolution. If a comb of honey is held with its surface at right angles to the centre of revolution and revolved, the honey of the outer cells will be thrown out, while the honey of the inner cells which face towards the centre of revolution will remain as it is, although these cells may be open, and will not be thrown out until the comb is turned so that these cells face away from the centre of revolution. On this principle many kinds of honey extractors are made and sold. They are of different capacities accommodating one or more than one comb to be extracted at a time. Each comb is protected by a wire-netting cage preventing the comb from breaking away from the frame.

While conducting the bee-keeping experiments at Pusa, a simple honey extractor * shown in Figure 72 was made. A A is a solid round iron rod

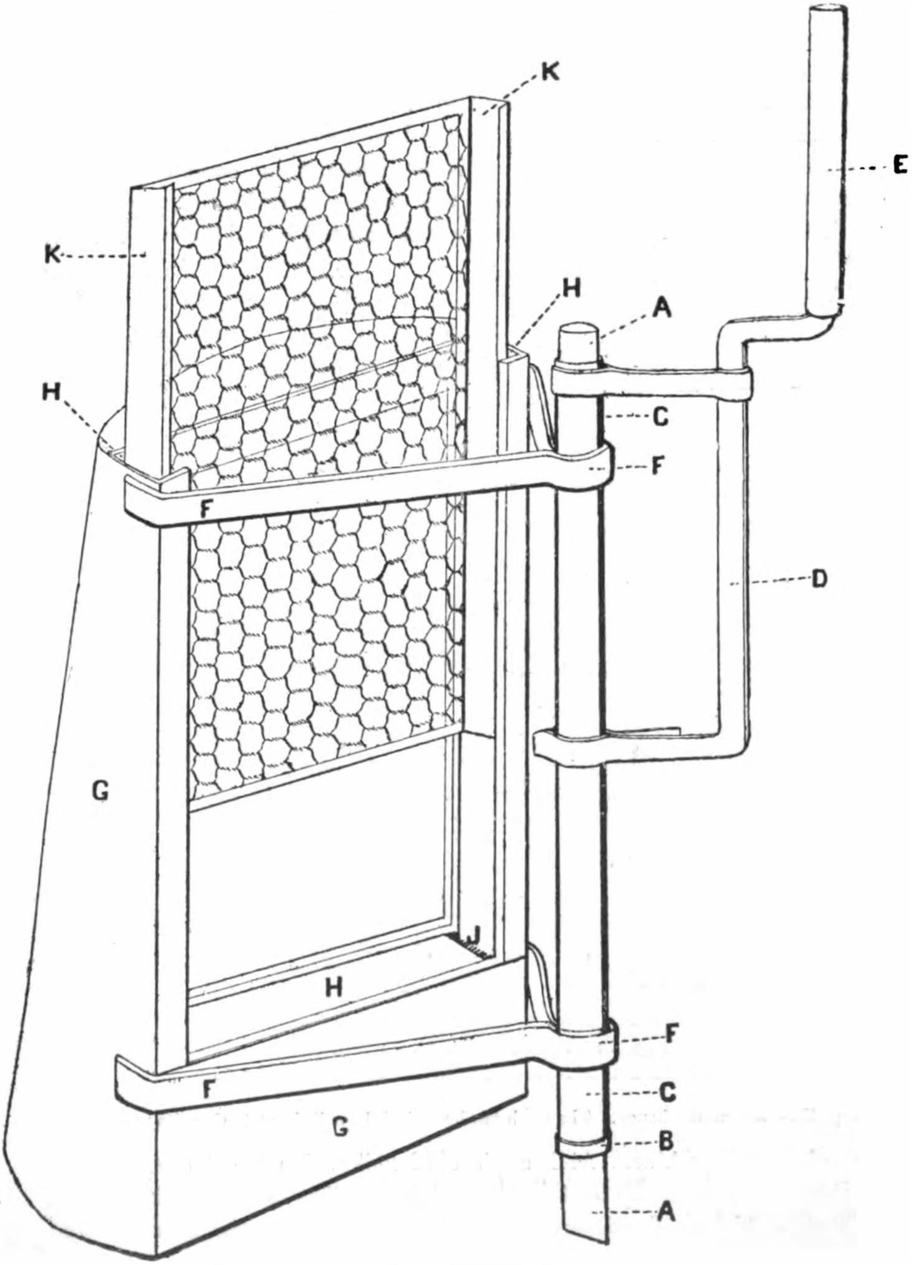

Fig. 72.
Honey Extractor.

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*Described in the *Agricultural Journal of India*, October, 1911.

pointed at the lower end for being driven into the ground. C C is a cylindrical iron tube which loosely fits over the rod, and is held at its upper part by means of the metal collar B soldered to the rod. To one side of C is rivetted the handle D and to its opposite side, two V-shaped arms F F which hold the honey-can G. The honey-can is made out of an ordinary kerosene tin. Inside the honey can there is a grooved wooden frame-work H, with a slot J at each extremity of the lower side to receive the projecting end of the frame of comb. K is the wire-netting comb-cage, shown drawn out. The comb is fitted into this cage and slid into the groove of H. In Figure 73 the comb is shown about half put in and the man is ready to revolve the machine. At E a piece of hollow bamboo loosely fits the handle and makes it easy to turn the machine. The comb-cage K is made of tin and galvanized wire-netting, the galvanizing of the netting being

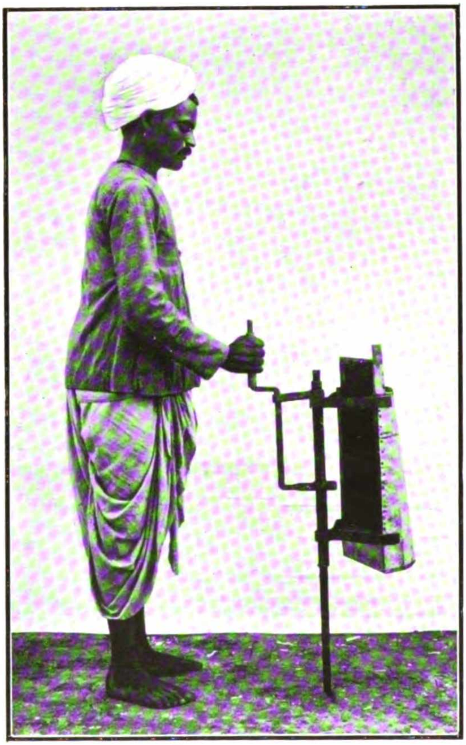

Fig. 73.—Extracting honey. The comb has been slightly pulled out to show its position.

carefully burnt off. No galvanized material should be allowed to come in contact with honey. The honey is thrown out and received into the can and then poured out.

Similarly a machine can easily be made to extract two or four combs at a time. A convenient one and much better than the above is shown in Figure 74. The comb-cages are fixed in a separate revolving part and there is a separate cylindrical drum in place of the fixed honey cans. The uncapped combs are simply stood against the wire-cloth walls and the machine revolved. This machine is an efficient extractor suitable for a tolerably large apiary. When making a machine the size of the comb-cage should be such as to receive a standard frame. Then the combs of the kerosene-box hive can also be extracted in the same machine.

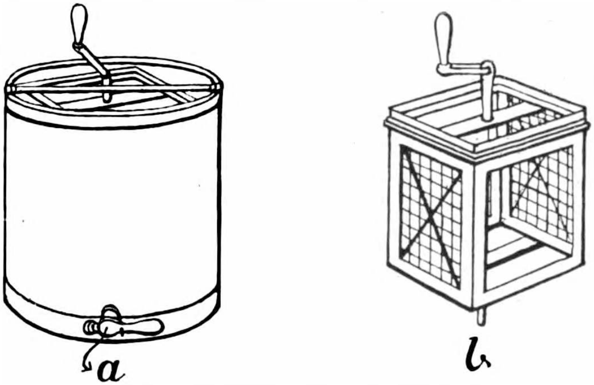

Fig. 74.—Cylinder Honey Extractor.
(*a*) Gate for drawing out the honey. (*b*) Revolving part with comb cages shown separately.

Extraction of Honey.

After the honey cells are capped the comb is taken out and the bees brushed off from it back into the hive by means of a feather. The comb is then taken away and the honey cells opened. This is done as follows :— Two honey knives are placed in hot water so that the blades may be heated. The comb is held in the left hand in a vertical or rather slanting position and stood on a dish. The cappings are sliced off by passing the hot blade of the knife flat on the surface of the comb and just under the layer of the cappings. When one knife gets cool it is placed in the hot water and the other used. Both the surfaces of the comb are uncapped in this way. If the comb bulges out anywhere, as it frequently does in the upper part, the bulging portion should be cut off so as to make the surface of the comb level. Then it is placed in the comb cage of the extractor. The extractor is revolved slowly at first and when about half the honey of one side has been extracted, the comb is turned so as to extract the honey of the other side. The extractor can be revolved with full force now and when this side has been extracted, the comb is turned back again to extract the honey left in the first side. When the comb is full of honey, the above method of extracting should be adopted. If revolved with full force from the beginning, the weight of the honey may break the comb. If, however, combs are not so heavy with honey, not being full of it, they can be revolved with force from the beginning. The comb will yet remain wet with honey after extraction and should be given back to the bees and will be soon licked dry by them. The honey is poured out of the can and strained through a muslin to remove broken pieces of cappings, etc. When a number of combs are extracted the cappings from them contain some quantity of honey. This honey can be got out from them in a pure condition if treated in the manner described in Appendix A.

Uncapping and extracting should be done in a closed place, for instance, inside a room. If done in an open place, bees will be attracted by the smell of the honey and will render the operation difficult. In the season of honey-flow when plenty of forage is available, bees may not be attracted, being busy with gathering honey. But during the period of decreased honey-flow or drought, bees are sure to be attracted and will come in numbers to rob the honey. All extraction should be done as the surplus is available. At least no extracting should be kept waiting to be done till the wet season. If left over till then, the honey will be of a deteriorated quality, as it rapidly absorbs moisture from the atmosphere and may ferment and become sour.

Also no combs should be stored away from the hive, which are not completely dry and empty. Combs containing pollen should be left with the bees. If there be any honey or pollen in the stored combs, both ferment and are attacked by a mould in the wet weather.

Ripening Honey.

As a rule the surplus honey should be extracted from the hive after it has been properly ripened by the bees themselves. This is indicated when the honey-cells are capped. Sometimes it becomes necessary to extract unripe or green honey in order to make room for more store. It can be ripened by the application of solar or artificial heat which will evaporate the excess of moisture. In places where the temperature in the hot weather goes beyond 100°F. ripening is easily done by leaving the honey for a few days in a tin vessel in a warm place. The hot temperature evaporates the excess of moisture. This is more quickly done if the vessel is placed in the sun. When the sun is not available, artificial heat may be used. The vessel may be stood near the oven in the kitchen or better in hot water. Direct heat should never be applied to honey which should always be heated when necessary by being placed in hot water which again should not be allowed to boil. It is best to evaporate the moisture slowly by being kept in a hot water bath with a temperature of about 150°F. and never going beyond 160°F. Many kinds of honey ripening vessels, called "honey-ripeners" have been made and are sold. When large quantities of honey are dealt with, it is convenient to have one. A simple and efficient one is a tall cylindrical or square tin vessel with a closely fitting cover. If a tap is attached at the lower part for taking out the honey, it is very convenient and quite satisfactory and complete. The extracted honey is placed in it and allowed to settle. Particles of wax which may be in the honey and the thin honey rise to the top. The ripe honey can be extracted from below and bottled.

Conditions necessary for the production of Surplus Honey.

A colony of bees will yield surplus honey under the following conditions:—

(1) The colony must be populous so that there will be enough bees to gather honey. A weak colony may not yield any surplus at all.
(2) The plants must secrete enough nectar.
(3) The climatic conditions must be favourable for the bees to forage. Bees cannot work on chilly, windy or rainy days. On warm windy days they go out to work but many are lost, thus weakening the colony.

If all the above conditions are present, a colony will yield surplus honey and a variation of these conditions will cause a variation in the amount of the yield. Items (2) and (3) are not within the control of the bee-keeper. But he can manage to have strong colonies when the honey-flow comes on. Here a knowledge of the time when the honey-flow occurs is useful. We know that worker-bees are born in about three weeks from the time the eggs are laid and they go out to forage in about two weeks after their birth. Therefore brood-rearing should be pushed at least about a month before the commencement of the honey-flow, so that there may be enough workers present in the colony ready to gather the honey as soon as available. We also know that more brood is reared when the bees get honey and pollen from outside. Therefore if they do not rear more brood when it is desired, they can be made to do so by giving them food, either honey or sugar-syrup and a substitute for pollen, either rye meal or wheat or oat meal. When it is not possible to strengthen colonies by stimulating breeding, two or more weak colonies may be united (see " Uniting ") to make a strong one. When however the colony is thus made strong, the bee-keeper may be faced with one difficulty and that is, that the bees may like to swarm and baffle his efforts by thus dividing themselves and consequently weakening the colony. Therefore precautions must be taken to prevent swarming.

Uniting.

Uniting is joining two or more swarms or stocks into one. The swarms of the Indian Bee are usually small and when many are available they can be strengthened with advantage by two or three being united into one. The simplest way of uniting swarms is to hive them together in the same hive. If one swarm has already been hived, another captured in the course of the same day, may be put in the same hive after first of all smoking both. Similarly swarms which issue out of one's own stocks may be united. Out of two or three queens which may be put in with the swarms only one will be allowed to live.

Two weak stocks may be united to make a strong one. For this purpose the stocks should be moved towards each other (see " Moving Bees ") until the hives are brought close to each other. Then on a bright day when bees are freely flying both the stocks are smoked well and the bees in both are sprinkled with syrup which is scented with peppermint. The peppermint will hide the distinctive smell of the two colonies. Only just so much peppermint should be used as will afford a smell. An excess of it has a choking effect. Cloves, aniseed or any other aromatic substance

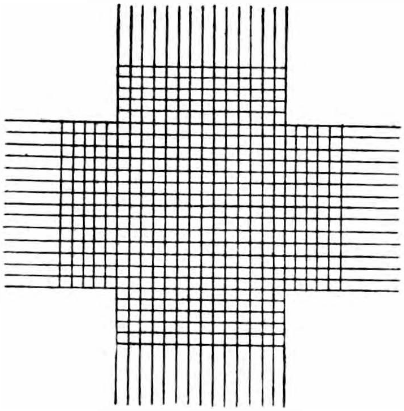

Fig. 75 a.—Queen cage.

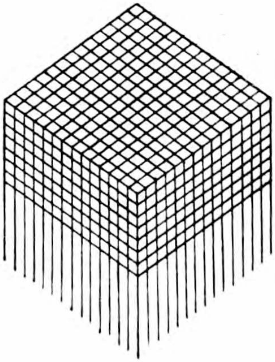

Fig. 75 b.—Queen cage.

may be used. Then the frames of combs from one are taken out and placed alternately with the combs in the other hive. The empty hive is removed and the occupied one placed in the intermediate position between where the two hives stood before uniting. The flying bees will come and enter this hive. Of the two queens only one will be allowed to live. If there be a choice between the two queens, the younger and better one may be protected by being confined in a queen-cage (Fig. 75) just before uniting. The other queen may be utilized elsewhere if necessary.

The queen-cage.—A simple and satisfactory queen-cage is made with a piece of wire-gauze by cutting off pieces about ¾ inch square from its four corners and then bending the sides as shown in Figure 75. Some strands of wire are removed from all the four sides up to about half of the cut portions. When complete, the cage should measure about 1¼″ to 1½″ each way and about ¾ inch deep. Another type of bigger cage is made in the same manner measuring about 4″ or 5″ in length, about 2″ in breadth and about ¾ inch deep. The wire-gauze with which these cages are made must have about 12 meshes to the linear inch. The queen is confined in this cage which is pressed into the comb up to about half its depth. She should better be confined towards the middle of a comb. The place where she is confined should have several cells of uncapped honey. If she has to be confined over capped honey, the honey-cells must be uncapped. If workers are just hatching out from a comb, the queen is better confined over the hatching bees with the bigger type cage with enough uncapped honey. If no hatching bees are available, the smaller type cage must be used. The hive is examined after about 24 hours and if the bees are hostile towards the queen, many walking over the cage rather angrily trying to sting her, she must be confined for another 24 hours. Then when they are reconciled to her, only a few sitting or walking slowly on the cage and smelling and caressing her, the cage is taken off.

When a stock becomes queenless through accident or death and if the bees have no opportunity of rearing queens to re-queen themselves and also there is no queen available to give them, the stock should be united with a queen-right colony. The queenless colony has to be moved to the queen-right one and then united, the queen being confined beforehand.

Prevention of Swarming.

Overheated and overcrowded bees are particularly prone to swarming. Therefore care should be taken to see that there are always enough empty combs for the queen to lay eggs and also for the bees to store honey. This can be secured by frequently extracting honey and adding more combs.

The hives should be shaded in the hottest part of the day and if necessary thick warm quilts may be dispensed with, keeping only a thin one so that there may be good ventilation. If many bees are found sitting near the entrance on the alighting board and vibrating their wings, arrangements should be made for proper ventilation. If enough space for the bees in the shape of combs is provided so that they may sit rather spread out, overheating of the bees will be minimized.

The queen should be kept towards the back of the hive behind the queen-excluder division board and when the combs to which she has access, are filled, they should be transferred in front of the queen-excluder and replaced by empty ones. As soon as drones are found in the hive, the queen should be thus confined by the division board. If the brood becomes overcrowded, a condition which will not happen always and certainly never before about the middle of the honey-flow, some of it may be given to weaker colonies. This is done by simply lifting a comb from the hive, brushing off the adhering bees back into it and putting this comb in the middle of the combs in the weaker colony. This removal of brood, however, should be done judiciously so as not to take away so much as to weaken the colony. Bees die quickly and in large numbers in the busy season and therefore much brood is required to replace deaths.

The hives should be examined frequently, every five or six days, and all newly-commenced queen-cells should be destroyed. If queen-cells are destroyed when they are just commenced or contain only eggs or young grubs, this goes a great way in preventing swarming. When the queen-grubs mature their destruction has hardly any effect. In the case of the Indian Bee, when the reigning queen has been confined at the back of the hive with an excluder dummy, a new queen may be allowed to be reared. The new queen will not lead out any swarm. The two queens will live amicably one on each side of the dummy. It is an advantage as more brood will be reared. Some bees are, however, such determined swarmers that they are not satisfied without swarming. In this case artificial swarming may be resorted to. (For artificial swarming see " Increase of Colonies.")

Increase of Colonies.

If it is intended to increase the number of colonies, it can be done in two ways:—

(1) *Natural swarming.*—The bees are allowed to swarm and the swarm captured and hived in a new hive. When a swarm issues from a colony it usually settles in a neighbouring place, on a wall or on the branch of a tree or bush and remains there for about half an hour. Then the whole swarm takes to wing

again and flies away to the place they select as their permanent quarters. Therefore the swarm must be secured when it has settled and before it flies away to a distance, or it is lost. In order to prevent after-swarms the colony from which the swarm has issued or as it is called the "stock," must be watched and as soon as a new queen has emerged, the bees will demolish the other queen-cells if they do not like to swarm again. If however, the queen-cells are not demolished and if the new queen which has emerged seems to be a perfectly healthy one, that is, not maimed or otherwise defective, it is advisable to cut out all the remaining queen-cells and not to allow the bees to build any more. The new queen is fertilized in time and the colony goes on. Thus two colonies are obtained out of one. There are many drawbacks in natural swarming. It is necessary to keep a watch for the swarm and when it issues it must be attended to at the expense of other, probably more important work. There is thus every risk of the swarm being lost. Therefore all bee-keepers resort to artificial swarming.

(2) *Artificial swarming.*—Artificial or forced swarming is dividing the bees in a colony without allowing them to divide themselves by natural swarming. If there is only one colony this is better done when the bees are making preparations for swarming (see page 20), that is, when the colony is full and queens are being reared. But it can be done when the colony is full and plenty of forage available. Select a bright day when the oldest queen-grubs are about ½ to ¾ grown. Have one hive ready with 4 or 5 frames with starters of foundation, a dummy and quilt. Go to the stock (or parent colony) in the middle of the day when the bees are flying. Take out the comb on which the queen is found and place it in the new hive. Now move the stock a little and place the new hive in its position. Take out some more combs from the stock and brush the bees from them into the new hive with a feather, replacing the combs in the stock. In this way about one-third of the bees found in the stock at the time may be brushed into the new hive. Then the stock should be removed to a distance of not less than six feet. The bees which are out in the fields will join the new hive. The bees in this hive may require to be fed and may be induced to build combs quickly if fed with sugar-syrup. It may do if two combs with honey have been put in from the stock. But care must be taken to see that

there are no queen-cells in the new hive. In the stock the bees will raise a queen. She will be fertilized in time and the colony will go on.

Thus two colonies are got out of one. This method of swarming is called "artificial" or "forced" or "shook" swarming or "dividing" bees. When there are more than one colony the results are more satisfactory if three colonies are made out of two. It is done in this way. Let the two stocks be numbered A and B, and the situations or stands they occupy as 1 and 2. To illustrate graphically, they are arranged thus :—

A stock	B stock
Stand No. 1	Stand No. 2

Swarm A and place A's swarm in stand No. 1. Move A stock to stand No. 2 and B stock to a new situation which is numbered 3. Therefore their position will be as follows :—

A's swarm	A stock	B stock
Stand No. 1	Stand No. 2	Stand No. 3

The flying bees of A stock will join A's swarm and those of B stock will join A stock. A stock is the only queenless colony and whether there are queen-cells already started in it or not, queens will be soon reared.

If it is intended to have four colonies out of two, after a few days but before any queen has been born in A stock, B may be swarmed and the colonies arranged in this way :—

A's swarm	B stock	B's swarm	A stock
Stand No. 1	Stand No. 2	Stand No. 3	Stand No. 4

B stock taking the place of A stock which goes to a new situation No. 4. There will be a number of capped queen-cells in A stock. Two can be cut out and given to B stock. The queen-cells should be cut out with a portion of the comb so as not to injure the queen inside, and fixed into a comb by means of pins as shown in Figure 76. The bees will soon join it to the comb with wax.

There are other methods of increase but they are not suitable for a beginner.

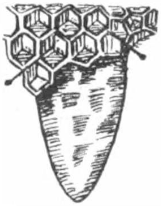

Fig. 76.—Queen-cell removed and ready to be pinned.

Re-queening Colonies.

(See "Relative Importance of the different members of the Colony," page 14.) In order that the colony may continue, it is necessary to replace the queen when old by a young one.

The queen of the Italian (and all varieties of the European) Bee retains vigour for two years and requires to be replaced by a young queen in the third year. Young queens are available for sale in countries where the Italian Bee is kept and in order to re-queen a colony, a young queen is purchased and introduced into the colony, the old queen being removed at the same time.

The queen of the Indian Bee too retains vigour for about two years. But these bees are very prone to swarming and when swarming takes place, the old queen goes out with the swarm and the stock is provided with a new queen every year. (See "Swarming," page 20.) Colonies which are allowed to swarm will re-queen themselves in this manner.

If however the old queen is replaced by a young queen early in the honey-flow season every year, it will go a great way in preventing swarming and will also keep the colony in an efficient condition. Re-queening of the colonies of the Indian Bee can be effected easily in the following manner, whenever there are drones present to fertilize new queens. In the Hills as well as in the Plains drones are bred in October-November and again in February-April. Confine the reigning queen to two or three combs at the back of the hive by means of a queen-excluder dummy, taking care that there are worker eggs in the combs from which the queen is excluded. The bees will quickly rear a new queen from these eggs and when this new queen begins to lay eggs, the old queen can be removed.

Another way of re-queening is to swarm a colony artificially. (See "Artificial Swarming.") When the new queen in the swarm begins to lay eggs, the old queen in the stock is removed and the stock reunited with the swarm.

What to do when a colony loses its queen.

When a colony loses its queen, see whether there are worker eggs or very young worker-grubs in any comb in the colony. If there are, cut off portions of the comb just below these eggs and grubs at several places. It may do, if only holes about 1½ inches in diameter are cut. The bees will build queen-cells over these eggs and grubs and rear queens and re-queen themselves. If there be no eggs or young grubs in this colony, a comb containing such eggs and grubs from another colony may be transferred to it and the comb treated as above. If there are capped queen-cells available from any other colony, a capped queen-cell may be given. The queen-cell should not be given until about 48 hours after the queen is lost. Otherwise the bees will destroy the queen-cell and also the queen-pupa in it. Sometimes the queen-cells are destroyed though given after sufficiently long periods. The queen-cells may be protected by the queen-cage (Fig. 75) which should be removed after about 24 hours, by which time the queen-cell will have acquired the smell of the colony. But queen-cells of which the tip has been thinned and the queen is about to emerge, should be caged in such a way that the emerging queen has enough moving space. By giving capped queen-cells the bees are saved much time.

It must be remembered, however, that the above plan will succeed only if there are drones available to fertilize the new queen. If no drones are available it is no use trying to provide a new queen to the colony and the best alternative is to unite with another colony. If a fertilized laying queen is available, she may be given to the queenless colony. She can be introduced into the colony by means of the queen-cage (Fig. 75). She is placed in the queen-cage the open face of which is then covered with a piece of stiff paper. This face is placed on the comb at the place where it is meant to confine her and the paper slowly pulled away and the cage pressed. It is better to brush the bees off from this comb before this. After confining the queen the comb is reinserted in the hive. The queen is released after 24 or 48 hours when the bees are reconciled to her.

[Queens should never be handled, as rough or careless handling may so injure them as to render them unfit for successful egg-laying. If handling is unavoidable they should be picked up very gently by the wings; under no circumstances should they be caught or held by the body. Queens do not sting and can be picked up quite safely. T. B. F.]

Wax from Broken Combs and Cappings.

Discarded or broken combs, cappings and all odd bits of comb should not be wasted. They can be easily rendered into wax. Although the broken combs and cappings are not saleable the wax can be readily sold, fetching a price of about 12 annas per pound when clean. By the ordinary traders wax is judged by its colour and smell. The natural colour of wax is yellowish white and it has got a characteristic smell of its own. Therefore it should be prepared and preserved in a way that will not affect its natural colour and smell. The methods of preparation or rendering are described below. It should be preserved in a closed box so that Wax Moth may not affect it, without naphthaline, etc. which hide its natural smell. Cappings and bits of combs should be stored in a closed box so that they may not be affected by the Wax Moth and rendered into wax when a large quantity is accumulated. In rendering wax, cappings and clean white new combs should be separated and rendered separately as they yield a larger quantity of wax with less trouble. Old black discarded combs, pollen-clogged combs and all combs which bees have used in rearing brood, should, before rendering, be cut into small pieces and soaked in water for about 24 hours, the water being frequently stirred and changed. The pollen and dirt will thus be removed.

The simplest way of rendering wax is to boil the cappings and combs with water in a tin or enamelled or earthen vessel. When the combs are melted, the water, while yet very hot, is strained through a cloth into another vessel in which it is left and allowed to cool. The cocoons, etc., which are known as slumgum, remain in the cloth. The wax, when the water cools down, collects at the top and solidifies as a cake. There is usually a little dirt at the undersurface of this cake and this can be scraped off with a knife. If there is too much dirt the cake is re-melted and the dirt which collects at the undersurface removed by scraping. The wax should not be boiled too much but only to the extent which is just sufficient to melt all the wax. It is better to bring the water to a boil and then put in the combs. Iron or zinc vessels should not be used. A kerosene tin does very well. The water used should be clean. If there is iron or lime in solution, the colour of the wax is affected. The colour of the wax is better if it can be melted in such a way that the heat of the fire does not come in direct contact with it. This can be done in the following manner: Water is boiled in a vessel, and the combs and cappings are placed in another vessel which is put over or in the boiling water. The hot water melts the wax which is therefore never over-heated. The melted liquefied wax is poured into a vessel with flaring sides and allowed to cool and solidify. The slumgum usually settles at the bottom and the liquefied wax can be slowly poured out. On this principle various kinds of wax-extractors are made and sold.

The solar heat is also used in rendering wax and will be found very useful especially in the Plains of India. The common type of Solar Wax Extractor is an oblong box with a glass cover. The inside is lined with tin. One end is raised so that the glass cover is sloping and faces the sun. The wax is melted by the sun's heat and runs down and collects at the lower end. In order to prevent the slumgum from running down to the wax, a wire-gauze partition is fixed some way from the lower end. The essential thing in a Solar Wax Extractor is that it should be perfectly air-tight so that the heated air may not escape. On this principle a handy

Solar Wax Extractor can be made in the following manner: An open-mouthed tin or enamelled vessel is embedded in dry saw-dust in a kerosene packing case and covered with a sheet of glass. The box is tilted up a little so as to face the sun. This conserves enough heat to melt the wax. A tin or enamelled bowl is placed inside the basin and a piece of cloth tied to its mouth. The combs are placed on this cloth. The melted wax strains through the cloth and collects in the bowl.

The wax rendered in a Solar Extractor is usually of a good quality. It is also very convenient to have a Solar Extractor. All odd bits of combs and cappings as they are obtained, are placed in the Extractor and the wax is rendered without any further trouble.

Protection against Enemies.

The creeping enemies such as ants, etc. are kept off easily by the ant-preventing device shown in Figure 29. These are earthenware vessels and can be easily and cheaply got made by local potters. They have to be kept filled with water. If one can afford one can have similar ant-preventers made of wood or metal. Care should be taken that mosquitos do not breed in the water by frequent change or by the addition of a little kerosene oil.

The Death's Head Moth is prevented from entering into the hive by using a piece of wood with indentations ⅜ inch × ⅜ inch as shown in Figure 77. This is placed in the entrance. The bees are not inconvenienced but the moths cannot enter the hive.

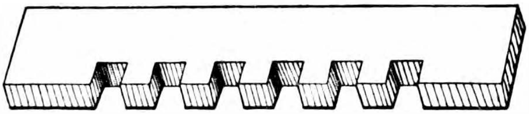

Fig. 77.—Death's Head Moth preventer.

Against wasps nothing very much can be done. They can be beaten to death by a broom as they come and hover in front of the hive. Some of them build hollow nests underground and if these nests can be traced, they can be destroyed in the following manner: At night the wasps are not active and do not leave the nest. A fire is made with charcoal in a small pot. The fire is placed near the entrance of the nest. The entrance hole should be widened a little if necessary. Now sulphur is placed in the fire and the hole of the nest with the fire is covered by a wide-mouthed vessel. The fumes will go into the nest and kill the wasps. It will be more effective if a little arsenic is mixed with the sulphur. Another method is to take a brightly burning torch (using kerosene oil) and hold the torch at the entrance of the nest which is now opened. The wasps fly out and are burnt in the flames. Another method is to pour a little carbon bisulphide,* about ¼ to ⅓ ounce on a little cotton lint and push this lint into the hole. After waiting for about a minute, apply a fire at the entrance from a distance, say using a live charcoal or burning candle at the end of a long stick. As soon as the fire is applied, there will be a small explosion and just at that time the entrance should be stopped by throwing a spadeful of earth on it.

The Wax Moth cannot be prevented from entering the hive at night. The Italian Bees protect their hive against this enemy successfully but the Indian Bee cannot. Hence when Italian Bees are kept, there is no trouble in the hive on this score. In the case of the Indian Bee, the hive should be frequently examined, the debris which collects on the bottom should be cleared and combs which are not covered by the bees should be taken out and stored elsewhere. Combs, which are covered by the bees, are not usually found to be attacked by the caterpillars. Probably for this reason queen-less colonies in which the bees dwindle away fall an easy victim to this enemy. If the combs are held against the light the galleries are easily visible and also the caterpillars themselves moving in the galleries. The caterpillars can be pulled out with a pair of narrow-pointed forceps and killed.

When the combs are stored, they are attacked by the Wax Moth caterpillars unless kept well protected in a closed box, into which Wax Moths cannot enter. Before the combs are stored, there may be eggs of Wax Moth in them and in that case all the combs in the store will be destroyed. The best and surest method of getting rid of Wax Moth is to fumigate the combs with carbon bisulphide after taking them out from the hive and before storing.

Fumigation is done as follows: The combs are placed inside an air-tight box; small cracks may be stopped by pasting paper over them and the box thus made air-tight. Carbon bisulphide is poured out on some cotton lint which is then put inside the box and the box closed. Leave the box closed for 24 hours. Better place the box at a distance where there will be no possibility of light or fire coming near it. Then take out the combs and store them. Examine the combs once again after about six days and if any caterpillars are found, fumigate them again. After this no further attention will be necessary and the combs will keep well if kept in a dry place.

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* Carbon bisulphide is obtainable from dealers as a liquid in bottles. A bottle containing a pound costs Re. 1. It is a highly poisonous and highly inflammable substance. Its smell should be avoided and no kind of fire, *e.g.*, lighted cigar, live coal or burning lamp should be brought near it. It should be kept in a well-stoppered bottle provided with a glass stopper and the bottle should be kept under lock and key and in a cool place.

Wax Moth breeds profusely in wild combs, which have been deserted by bees. Therefore all such combs in the neighbourhood should be searched out and either buried deep under the ground or burnt or melted into wax.

Care of Honey.

Honey should never be left exposed. Being hygroscopic in nature, it readily absorbs moisture from air and is sure to ferment and becomes sour later on even when covered afterwards on account of the excess of moisture. Properly stoppered glass or china or tin vessels keep it well. It should not be allowed to come in contact with zinc. It should not be stored in damp moist places but keeps best in dry warm rooms, even a temperature of 100° F. doing it no harm. Conditions which will keep salt well will keep honey well.

Granulation of Honey.

All good pure honey granulates in time and may become thick and solid. This is called candying. Sometimes candied honey is cut out in the form of bricks—known as " honey bricks " and sold wrapped in paper. Granulated honey may be liquefied by being placed in the sun or in a water-bath, the water being hot but not boiling. (See under " Ripening Honey. ") Sometimes only a part of the honey in a vessel will be found to have granulated, the remainder being in a liquid state. When this happens, the granulated portion should be liquefied and the whole mixed before taking out any honey from the vessel, because in such cases some constituents of the honey predominate in one part and some in the other.

Marketing Honey.

The best way of offering honey for sale is in small 1 lb. jam bottles with screw top cover. It sells quickly when offered in small quantities, orders for large quantites being executed otherwise.

Moving Bees to Different Pastures.

The main honey-flow in the Hills occurs in October-November and that in the Plains in spring. The same bees may be made to gather honey in both the localities. For this purpose they have to be moved up to the Hills in September and brought down to the Plains in December. This plan may give good results, as the colonies by being worked in a honey-flow in October-November will be in a good condition to gather the honey in the spring flow in the Plains. As some may adopt this recommendation, some directions seem to be necessary as regards the best method of transport. For this purpose travelling boxes are necessary which will allow of enough ventilation through all parts of the box A simple but quite efficient travelling box is shown in Figure 78. The cover and bottom are made entirely of a coarse wire-cloth with about eight meshes to the linear inch. A few holes protected by wire-cloth are also provided at the ends. The box is made of a size to receive frames of combs and when covered, the frames are held tightly in the place so as not to move or strike against one another in transit. If there is enough honey or sugar-syrup in the combs, the bees will travel well without any further attention. The travelling boxes containing bees can be loaded one above another in a covered truck which will protect them from sun and rain but will allow sufficient ventilation. The boxes should not be exposed or left in the sun. The bees are transferred into travelling boxes after dusk when all flying bees have returned to the hive. The transferring is done by simply lifting the frames of combs with bees and placing them in the travelling box. If any bees sit on the sides of the hive they can be swept down on the frames. On arrival at the destination they are transferred into proper hives during the day time. When arrived at night the transferring should be deferred till the morning.

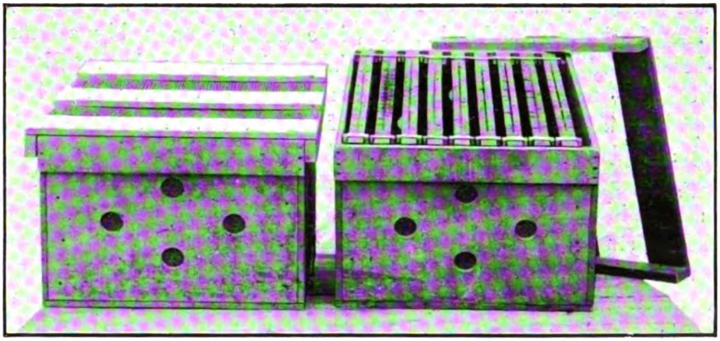

Fig. 78.—Travelling box.

The Bee-Keeping Industry.

While it is not improbable that in time there will be bee-keepers in India who will own several hundred colonies of bees and make a living out of them, it must be noted that bee-keeping is best practised as a subsidiary industry. The reader should now be in a position to understand that the nature of the industry is such that it keeps a man engaged only for a part of the year, *viz.*, the season of the honey-flow and for some time preceding and following it. One cannot expect a steady income from bee-keeping because regard must be taken of bad years which will be poor in honey-flow and also of loss of bees through enemies or diseases.

The beginner should beware of embarking on a big scheme of bee-keeping all on a sudden, especially in an unknown locality. There is no means of testing the honey-yielding capacity of a locality except by keeping a few colonies of bees there. Although in India there are places, *e.g.*, the Hills, which are sure of yielding surplus honey, an ambitious scheme should not be undertaken without first of all gaining the experience and skill required to work bees. Bee-keeping is best started with a few colonies which may be increased as experience is gained. With experience a man can easily manage a few dozen colonies in his spare time and with the help of his domestic servants.

Appendix A.

How to extract honey from wild combs.

Good honey, which will keep for years, may be obtained from wild combs if extracted in the following manner instead of squeezing it out of the combs. The honey is stored in the comb in its upper part while the lower part contains brood. The part containing brood should be cut off and rejected. Then take off the capping of the honey by means of a broad bladed knife. If an extracting machine is available, the honey can be easily extracted in it. If no extracting machine is available, cut the comb containing honey into small pieces and place these pieces on a piece of muslin loosely tied over the mouth of a bowl or widemouthed clean earthen vessel as shown in Figure 79 and tie another piece of muslin tightly over the mouth of the vessel. This second muslin is to prevent bees from robbing the honey. Now place the vessel in the sun. The honey will ooze down quickly and can be at once bottled or otherwise taken care of as described in the book. The vessel can be placed inside a warm room or kitchen. But direct heat should not be applied as it may melt the combs. If done inside a room where bees may not have access, it can be managed in a much simpler way, the cut combs being placed inside a muslin and hung up somewhere and the honey allowed to drip in a vessel placed below. What is wanted is to see that the honey contains no foreign stuff, *e.g.*, pollen or juice of brood which should be scrupulously avoided and that the combs are not pressed. If done neatly in this way, the honey, that is obtained, is in no way inferior to that extracted in a proper extracting machine. (see "Care of Honey.")

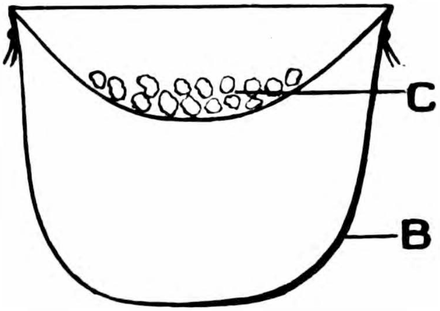

Fig. 79.—B.—Vessel. C.—Pieces of comb.

Appendix B.

A note about appliances.

Of the various appliances described in the book, the following are necessary to make a beginning. Unless European Bees are kept, no other appliances are required :—

1. Hive. This can be made locally. A kerosene-box hive costs about Rs. 3. A well-made standard hive costs about Rs. 8.
2. Frames. One dozen for each hive. They can be made locally. Cost about Re. 1 per dozen.
3. Metal ends. One dozen for each hive. They have to be purchased ; cost about as. 3 to 6 per dozen.
4. Dummy or Division Board. One for each hive. It can be made locally ; cost about as. 3.
5. Queen-excluder dummy. One for each hive. It has to be purchased ; cost about Re. 1.
6. One Smoker. Has to be purchased ; cost about Rs. 2-8-0.
7. Ant-preventers. Four for each hive. Earthen ones can be had, made locally ; cost about as. 2 for four.
8. Quilts. One sheet of gunny cloth or *durry* and two sheets of blankets : can be cut out from old rejected gunny bags and blankets , cost about as. 4.
9. Honey Knife. Two or one may do ; can be made locally ; cost about as. 3.
10. Wire comb-fixers. One or two dozen ; can be made locally ; cost about as. 6 per dozen.
11. Gloves. One pair ; to be purchased ; cost about Re. 1.
12. Veil. One ; can be made at home ; cost about as. 4.
13. *Matla.* Can be made locally , it is not necessary for those who wear hats ; cost about one anna.
14. Honey-extractor. One can be used by several bee-keepers. Although it can be made locally, it is better purchased. One can be had made for about Rs. 10. Good ones can be had for about Rs. 12 in England, which are sold in India for about Rs. 32. If there be a demand, the price will probably be lowered.
15. Comb foundation. One dozen sheets for each hive. All may not be used at first ; has to be purchased ; cost about Re. 1-8 per dozen sheets.

16. Tinned wire. Has to be purchased ; cost about as. 2 per small spool.
17. Wire embedder. One; a "pice" embedder can be made locally ; cost about one anna.
18. Embedding board. One can be made locally ; cost about as. 2.
19 Feeder. Bottle-feeder can easily be made ; cost about annas 2.

The above outfit costs about Rs. 22 with a kerosene-box hive and about Rs. 5 more with the standard hive. For learning the work, the beginner may commence with a kerosene-box hive and need concern himself with items 1 to 13 only and he can have about half a dozen frames which are ready fitted with wire and foundation. The cost will be about Rs. 11 or 12.

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[*continued on page iii*

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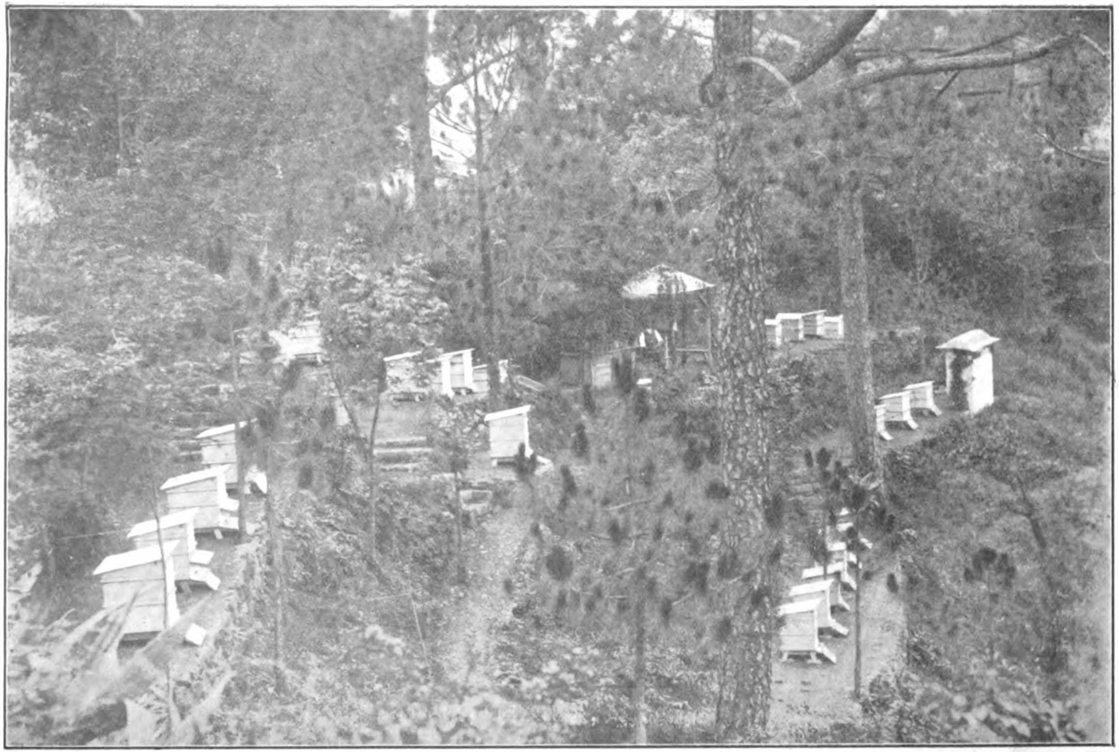

APIARY, SANAWAR, PUNJAB, JULY 1916.

A GUIDE TO SUCCESSFUL BEE-KEEPING

IN THE

Hill Districts of Northern India

BY

F. S. COUSINS, LIEUT. (RETIRED),

APIARIST.

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INTRODUCTION.

THOUGH many books have been written on the subject of bees and bee-keeping, a manual for the guidance of those engaged in Apiculture in the hills of India has not yet appeared, and as I have had some 25 years' experience in this most fascinating and profitable occupation, I venture to place that experience at the disposal of those who, like myself, are lovers of nature and desire to manage their hives according to modern methods, thereby enabling them not only to make themselves acquainted with the instincts and habits of one of the most interesting of God's creatures, but also affording them an opportunity of adding a little to their income.

This guide does not profess to deal with the natural history of bees, or with the many devices adopted for their management. I shall content myself rather with a description of those hives, methods, and appliances which from practical experience I have found necessary, and would refer those bee-keepers who desire to go more deeply into the subject to such standard works as the "British Bee-Keeper's Guide Book" by Thos. W. Cowan, and "Fifty years among the Bees" by Dr. C. C. Miller. The former work was the one I used as a beginner; a later edition has recently been published, and I strongly recommend it.

I am particularly interested in improving the methods adopted by the ordinary Indian villager, and to that end have devoted a special chapter to a description of frame hives suitable for building into the wall of a house, enabling the bees to be manipulated and honey taken without destroying the bees.

Apart from the use this little manual may be to those who can afford the necessary outlay for detached frame hives, some good will have been achieved if it results in the introduction among the rural population of methods of bee-keeping at once more humane and certainly more profitable. In this district of Simla alone many hundreds of thousands of bees must annually be destroyed to secure a comparatively small quantity of honey, and that at best impure and in many cases unwholesome. It took many years to overcome the prejudice against frame hives in England, and even now, in some out of the way places the old straw skep with its attendant "brimstone pit" are still in use, but in India, where the unnecessary destruction of animal life is contrary to the teaching of the religion of the people, the "better way" one would think needs only to be known to be adopted.

A Guide to Successful Bee-keeping in the Hill Districts of Northern India.

How to commence bee-keeping.

I AM so frequently asked " How shall I commence ? " that I cannot do better than describe how I acted—it will at least have the merit of personal experience.

I first procured a frame hive (see chapter on hives), a smoker, bee veil, stout gloves (those sold by Cashmiris at 4 or 6 annas a pair are best), a large knife, some pieces of tape, a tin basin, and a flat board. Provided with the above, I proceeded late one evening in early March to an out-house where a colony of indigenous bees (*Apis indica*) had established themselves the previous year. I cut away a portion of the ceiling cloth, and well smoked the bees, thus driving them off the outer comb. I then cut the first comb out and tied it into an empty frame with three pieces of tape passed under the comb and over the top bar, then more smoke and the operation was repeated until I had transferred the whole of the comb into the hive in the same order that it had occupied under the roof of the out-house. The bees were by this time in a state of great confusion, but many had clustered in a corner of the roof. These I carefully swept off into the tin basin, threw them gently down in front of the hive entrance, (which I had enlarged for the purpose by raising the front of the hive an inch or so) when the whole mass eagerly entered the hive and clustered up among the combs. I waited a while until the bees on the wing had settled, when I treated them in the same way. The whole operation took me perhaps two hours. I then carefully carried the hive to the position it was to occupy permanently, and the following morning the bees were working well, having quite taken to their new house. The next day but one I opened the hive, cut through the pieces of tape I had tied the combs in with, and gently removed them.

A few bees, about a pint the first night, and half a pint the second, returned to the place formerly occupied by them, but these I easily brushed off into a tin and inserted in the hive. After the second night I had no more trouble. The out-house from which I removed the bees was situated about 400 yards from the place I had selected for my apiary. From this small beginning, with the addition of one or two swarms which I purchased, in 3 years I built up my apiary, until it numbered 16 hives, besides those I had disposed of to friends, and I was well repaid for the trouble and expense I had incurred. Of course I had by me a good manual on Apiculture, but I found that to ensure success, there being no book dealing exclusively with indigenous bees, it was necessary to test practically the instructions given therein, and introduce modifications where necessary.

An easier way to commence is to secure a swarm in April and start them in a hive the frames of which have been fitted with strips of Comb Foundation; but care should be taken that the swarm contains a large number of bees. A *first* swarm generally fulfils this condition. After-swarms are mostly too weak to give good results, though I have been successful with them. In ordinary seasons swarms are readily obtainable in the hills during April, and should be hived as soon as possible after they have clustered. To the novice the operation of transferring the swarm from the tree or place where it has settled may seem a dangerous undertaking, but this is not the case if certain precautions are taken. Though I have frequently hived swarms without any protection to my face or hands, I would recommend the beginner to wear a veil and gloves, and thus protected he has nothing to fear. It is a well known fact that before leaving the parent hive bees gorge themselves with honey, and whilst in this state are far less prone to sting than at other times. From the end of a bough, or from a low shrub, there is no difficulty in securing a swarm. The hive the bees are intended to occupy having been previously made ready, *i.e.*, fitted with, say, 8 frames and a division board with a cloth spread over the top, and the front propped up an inch or so on two small stones, all that has to be done is to hold a light box or basket just under the cluster with one hand, and give the branch a sharp shake with the other hand, when nearly the whole of the bees will fall into the receptacle. If this has been properly done comparatively few will fly away, as they cling too tightly to one another readily to disengage themselves. Now without loss of time invert the box and by a sharp jerk downwards precipitate the mass of bees just in front of the hive. (Do not use unnecessary violence or the queen may be injured). The bees will then enter the hive and cluster up among the frames. Wait a minute or two to see if the bees have a tendency to return to the place where they had originally settled, in which case the operation must be repeated; but if the queen has entered the hive the remainder will soon follow.

When swarms settle on a tree trunk or place which cannot be shaken, then the bees must be carefully swept off with the gloved hand or light broom and allowed to fall into the box placed just below to receive them, and immediately shaken in front of the hive.

Sometimes it is possible to hive the little people by placing the hive itself (without the floor board) just above the cluster, and by syringing them gently with clean water drive them up among the frames.

As soon as all or very nearly all the bees have entered their new quarters it is advisable to move them to the place intended for their permanent position, and disturb them as little as possible for at least 24 hours.

In another section I give instructions how to proceed when placing swarms in frame hives permanently fixed in walls of houses.

Hiving swarms in villager's frame hives.

The procedure explained previously must be followed exactly so far as regards the removal of the swarm from the branch or place where it has settled; but, as the hive is a fixture in the wall of a house and cannot be brought near to the swarm, the light box must for the time being be treated as a hive, and after the bees have been shaken or brushed into it, it must be carefully inverted on to a piece of board, and one side propped up an inch or so with a small stone. Should all, or nearly all, the bees have been secured little remains to be done but to close the box, carry it carefully to the frame hive and, after separating the frames and leaving an opening of, say, 8 inches in the centre, by a sharp downwards jerk project the bees on to the hinged door of the hive which is conveniently placed for this purpose. It is well to take the precaution of having two or three folds of cloth smoothly spread on the open door to prevent possible injury to the queen. The bees will readily enter when the door

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should be closed. The frames and division boards can be adjusted later to suit the size of the swarm and the position they have taken up within the hive. It is better not to disturb a newly hived swarm for some 24 hours, or they may clear off if meddled with before they have commenced to work in earnest.

Hives and appliances.

Since the introduction of frame hives so many different styles have been adopted that I shall not attempt to describe more than three, one a modification of the "Cowan" hive suited to the common bee of the Simla hills, and which I have thoroughly tested: and the others villagers' hives which are suitable for building into the wall of a house. All the three hives take the "Standard" frame, slightly altered, for local requirements.

The modified Cowan hive consists of a floor board, body box, outer case with one lift and roof sloping towards the rear. It is desirable to use timber cut $\frac{7}{8}$ inch thick for the walls of the hive and $1\frac{1}{4}$ inch for the floor board. Legs may be provided if desired. With regard to measurements the one important thing to recollect is, that every hive in the Apiary should be so constructed that the frames are transferable, *i.e.*, *the interior measurements of the body box and the outside measurements of all the frames must be exactly alike.* To this end I give below detailed measurements of the standard frame, and if a quarter of an inch is allowed between the ends of the frames and the sides of the hives and the same space between the floor board and the bottoms of the frames the remainder of the hive may be constructed according to the fancy of the builder, provided sufficient space, say, $1\frac{1}{2}$ inch, is left between the body box and the outer case to protect the bees from sudden changes of temperature or to allow of the intervening space being packed with *bhoosa* during very cold weather.

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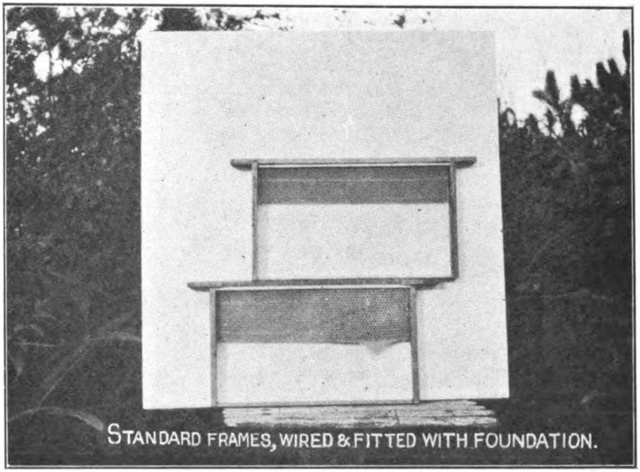
Standard Frame.

The photograph will give a general idea of this, but as outside measurements of the frames are of great importance to ensure success I give them in some detail—



STANDARD FRAMES, WIRED & FITTED WITH FOUNDATION.

Top Bar.—17 inches long, 1-$\frac{3}{16}$ inches wide at each end, eleven inches of the length being reduced in width to $\frac{13}{16}$ of an inch.

Side Bar.—1-$\frac{3}{16}$ inches wide, 8½ inches long (including the thickness of the top bar). This to be securely fastened to the top bar leaving a projecting shoulder of exactly 1½ inch at each end.

Bottom Bar.—¾ inch wide

The thickness of the top and side bars may be inch and that of the bottom bar $\frac{3}{16}$ inch.

The measurements outside the frame are thus :— Along the top bar 17 inches, across the frame 14 inches, depth of frame 8½ inches.

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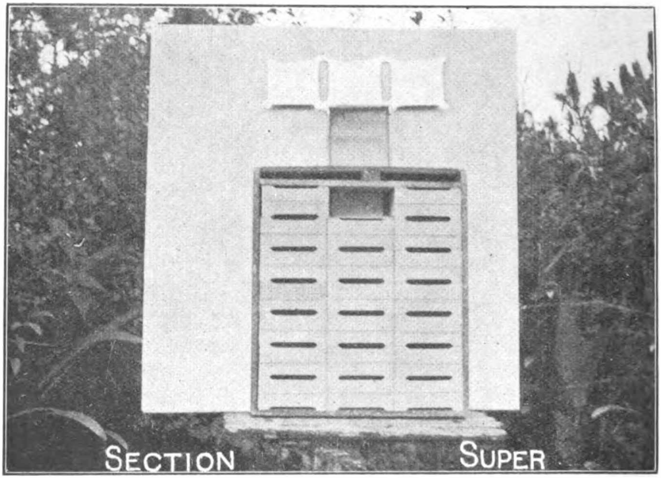
Supers.



A description of the "Cowan" or any other detached hive would be incomplete did I fail to notice the "Super," or that arrangement of small boxes placed on the top of the body box to secure comb honey. No hive is complete without its super or rack of sections, and though it is the experience of many that hill bees do not readily work in the sections, even when provided with full sheets of comb foundation, that they can be induced to do so I have amply proved.

Section boxes can be bought so cheaply that it is certainly better to obtain them that way than to attempt to make them, but the rack to hold the sections can easily be made. The dimensions for a rack to hold 21 one-pound sections are as follows:—Length 15¾ inches, breadth 13 inches, depth 4⅜ inches (inside measurements). Strips of wood 1¼ inch wide should be nailed to the bottom at the sides and two strips 1 inch wide should also be fastened to the bottom, dividing the open space to support the sections, thus allowing the bees to enter the sections from below. The wood for the bottom strips should not be more than ¼ inch thick; that for the body of the rack may be ½ inch. A thin piece of wood 13 inches × $4\frac{3}{8}$ inches and a small wedge together with 6 zinc separators, to be placed between each group of three sections, enable them to be snugly packed in the rack and ensure flat combs. Each section should be provided at least with a starter of comb foundation ; if full sheets are given so much the better.

The villager's hive.

This is a hive designed for building into the wall of a house, and may be made of common $1\frac{1}{2}$ inch pine-wood provided it is well seasoned, and does not smell too strongly of turpentine.

The *inside* dimensions should be exactly :—

$17\frac{1}{2}$ inches from front to back :
18 inches broad :
$8\frac{5}{8}$ inches deep :

with a door in front hinged at bottom, and a hook fastening at the top. The outside of the box need not be planed, but care must be taken to have the inside very true and smooth to enable the frames to be withdrawn and replaced without unnecessarily disturbing the bees. When building it into the wall it is also of the utmost importance that the bottom should be perfectly *level.* A hole 1 inch × $\frac{1}{2}$ inch must be cut in the thickness of the bottom of the box at the back ; it should slope upwards to form a passage-way for the bees to enter under the frames $2\frac{1}{2}$ inches inside, the passage to be broadened to 4 inches. This arrangement, provided care is taken to keep the frames close together, prevents the possibility of the bees occupying the space between the ends of the frames and the back of the box. Nine frames, wired and fitted with strips of comb foundation, and two division boards the exact size of the standard frame, with small triangular pieces of wood nailed on the side at the bottom to allow the boards without further support to stand close against the frames, complete the furniture of the hive ; the whole costing less than 5 rupees.

This hive (with the aid of an extractor) will enable the villager to obtain much more honey than he does at present, and that pure, and *without the destruction of his bees.* It will last for many years, and by using the standard frame he can, as he gains in experience, control swarming, strengthen weak stocks to take full advantage of a honey flow, raise bees for sale, *and eventually transfer his stock into modern detached hives*, when he will obtain the fuller advantage of supering and doubling which in other countries has made bee-keeping such a profitable industry.

Another excellent Wall Hive has been designed by Mr. C. C. Ghosh, B.A., of the Agricultural Research Institute, Pusa (full particulars of which are given in Bulletin No. 46-1915 issued by the Institute and obtainable from the Superintendent, Government Printing, India; price annas 14). The following sketches taken from the Bulletin referred to are sufficiently clear to show the advantages of the hive.

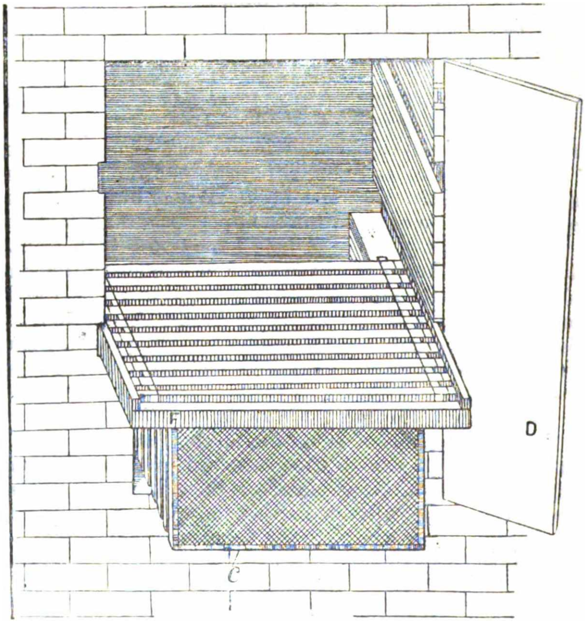


Fig. 1.—Movable bar frame wall hive. The door (D) has been opened and the comb-carrier frame (F) with the combs (*c*) in position has been half drawn out.

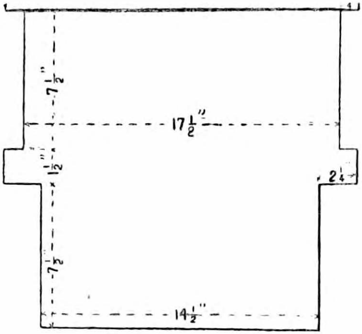


Fig. 2.—Measurements of the wall hive

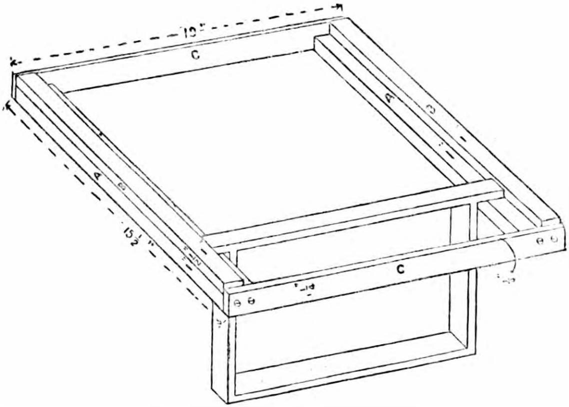


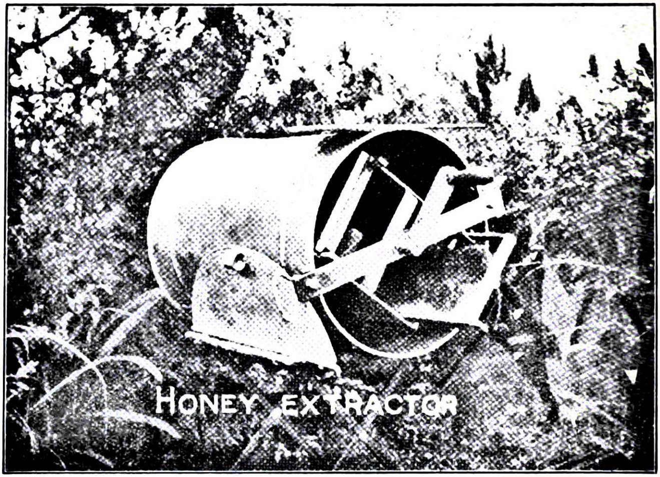
Fig. 3.—Comb-carrier frame for wall hive.

When this hive is used for the indigenous bee, it is scarcely necessary to make two upper chambers; the hive as designed in figure 2 affords ample accommodation.

The introduction of a swarm to this hive is facilitated by having the door hinged at the bottom, when the procedure is as laid down on page 3.

The honey extractor.

There are many forms of extractors on the market, but at present I know of no Indian firm which makes and sells them. Probably as the demand increases they will be procurable in this country. The one I am familiar with is "the Guinea" sold by Overton and Sons, Crawley, Sussex—the photograph will make clear its general appearance.



Two frames should be operated on at one time, as the machine works better if the cages holding the frames are fairly balanced. The adhering bees should be first carefully removed from one frame by holding it by the shoulders and bringing it down with a sharp jerk to within a few inches of the exposed frames in the hive, the remaining bees being gently brushed off with a feather or light brush. The second frame should then be similarly treated. The honey to be extracted is first uncapped, one side at a time, by means of a large knife, the frame being held upright and the caps of the cells sliced off commencing from below; the two combs are thus uncapped and placed in the extractor, when a few turns of the machine causes the honey to be thrown out without injury to the combs, which, after the other side has been similarly treated, may then be returned to the bees to be refilled. The advantages gained by the use of the machine are obviously great.

Comb foundation.

For frame hives of any description it is necessary to provide the bee with some guide to ensure the combs being built just where they are required. For this purpose nothing is better than wax foundation, which is sold by most reliable firms who deal in bee-keeping appliances at 2*s.* 3*d.* per pound. It is obtainable in sheets, 8 of which go to the pound, and are of the correct size for standard frames. It is unnecessary to use whole sheets. In practice I have found that if the sheets are cut into three length-ways, that affords quite sufficient guide for ordinary use, and costs in this country about 1½ anna per frame, say, one rupee for a 10-framed hive. Any one taking up bee-keeping in earnest will not grudge this small outlay, when he has once experienced the immense advantage obtained by the use of this valuable invention.

One caution is needed. Only the best "Weed" foundation should be bought. Cheaper kinds are to be had, but they will not stand the Indian climate.

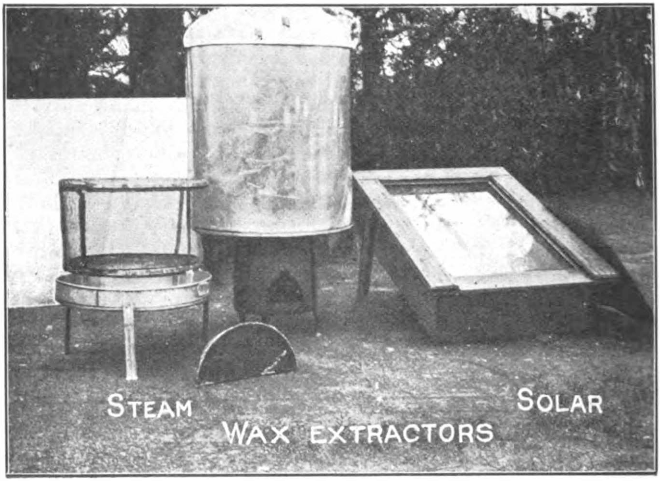
Wax.

All odd pieces of wax and rejected combs should be carefully kept in a closed vessel where the bees and wax moth cannot get at them, and periodically melted down.

The photograph of the wax extractor I use explains itself.

To the right of the photograph will be seen a "Solar" wax extractor, which is merely a box painted black with a sheet of glass let into the lid and placed so that the sun's rays fully enter the box. The lid being hinged, this extractor forms a convenient receptacle for odd pieces of comb which should never be left lying about.

It often happens that when preparing bees for wintering, combs, too good to break up, have to be taken from the hives. These should be carefully examined and, if quite free from wax moth grubs or other vermin, be stored away in a suitable box with one or two pieces of napthaline to keep off the attacks of that worst of pests to bee-keepers in the hills, the wax moth.



Stings.

Many persons are afraid to keep bees because of their stings. Doubtless it is unpleasant to be stung, but from practical experience I can safely assert that, apart from the momentary pain and in some cases subsequent slight swelling, stings do one no harm. I go so far as to say that the tiny drops of poison injected by the common honey-bee does good rather than harm in the case of those afflicted with rheumatism. I know of no sure remedy for stings though many are sold. The sting itself should be removed as soon as possible, as, though separated from the body of the bee, it has the power of working its way deeper into the skin. After being stung many times all one feels is a slight prick, but no after effects. A veil should certainly be used to protect the face when performing any operation with bees likely to excite their anger, but gloves hamper one in the work and should not be generally used.

Frame holder.

A simple device for temporarily holding the frames when it is necessary to remove them from a hive should be in every apiary. It is very convenient to have both hands free when cutting out queen cells, or removing tapes which have been used to fasten combs in the frames when transferring. A strong suitable holder can be made as follows:—Take a piece of wood 17½ inches × 9½ inches × 1½ inch thick, cut square 1¼ inch pieces out of the corners and screw 4 uprights 1¼ inch square by 14 inches long to the corners—let these pieces project 1 inch below the board to which they are screwed to form short legs—two 1¼ inch × 18 inch pieces mortised into the uprights, allow easy working space for standard frames and complete this useful article.

Management in the rains and in winter.

During the rains it is extremely important to keep the hives as dry as possible, and advantage should be taken of sunny days to air the top coverings and remove all spare combs not occupied by the bees. Ants are sometimes troublesome at this time and should be guarded against.

In December it is a good plan to fill the spaces between the outer case and the body box of all hives with clean dry *bhoosa* and place a bag made of some common thin material partly filled with the same, above the quilt. (The bag should be made a trifle larger than the inside of the hive).

Disturb the bees as little as possible during cold weather: and when snow is on the ground the entrance should be shaded from the glare by a piece of wood.

To "winter" bees successfully it is of great importance that (*a*) the stocks should be strong; (*b*) that they have sufficient stores for their needs; (*c*) that they be kept dry, and free from draughts, and (*d*) when the weather is very cold the hives must not be interfered with in any way which will excite the bees.

Feeding.

About the end of October stocks should be examined to see if they have sufficient stores to last them through the winter. An average stock on, say, seven frames, requires at least four frames well loaded with honey. If short of food the bees must be artificially fed on syrup made of good *cane* sugar and water—ten pounds sugar, five pints water, half ounce salt—boiled for about three minutes.

The bottle and stage feeder referred to in the price list at the end of this guide may be used to feed the syrup to the bees through a hole cut in the quilts on top of the frames: by its use the flow of the liquid can be regulated, so that the bees may quickly store it in the combs. It is advisable to place feeders in position in the evening and to keep them well wrapped up.

A cake of candy placed over the frames under the quilt may be given in January if it is seen that stores are running short—a mild day must be chosen for this. Six pounds *cane* sugar and one and-a-half pints of water boiled for about one minute and poured into saucers to cool will make suitable candy, though it is wiser to get the services of a regular sweetmeat maker to obtain a really satisfactory article. Well made candy should be soft yet firm and with a smooth grain. Never feed liquid food to the bees when they are confined to the hive by cold weather.

In the spring when the bees are flying freely, weak stocks may, with great advantage, be slowly fed on a syrup made of *cane* sugar ten pounds, water eight pints, salt one ounce; boil for about three minutes. This will stimulate breeding in the hive.

Water for bees.

It is very essential that bees have access to a plentiful supply of clean drinking water. A large wide-mouthed bottle of water inverted on to a plate, or better still, a square piece of wood having one-eighth inch sawcuts in its face, and kept always in one place in the midst of the Apiary answers the purpose very well. It will soon be discovered by the bees. A spoonful of salt may be added to the water with advantage.

Importation of European bees.

In the foregoing pages the common indigenous bee of the country has alone been considered. The introduction of European bees, owing to the prevalence of disease in the West, should only be attempted when the source from which the bees are obtained is entirely above suspicion. At present, "Foul Brood" and the "Isle of Wight" diseases are unknown in India.

Simla Bee-Keepers' Association.

This Association was started in September 1914 for the purpose of encouraging Apiculture in the Simla district.

Among other advantages, members have a visit from an expert once a year free of charge. Expert opinion and advice from a Bee-Keeper of long experience in the hills, and the loan (when the residence of the member renders this practicable) of such plant as the Association is able to purchase.

Subscription Rs. 3 per annum. Subscription to "The Bee-Keepers' Record" (a monthly journal) Re. 1-8-0 per annum.

The President of the Association is the Director of Agriculture and Industries, Punjab, and the Honorary Secretary, Lieutenant F. S. Cousins (R. L.) Sanawar, Punjab.

Bee-Keepers are invited to join this Association.

Price List of Bee-Keeping Appliances sold by E. Plomer and Co., Simla.

		Rs.	A.	P.
1.	The Cowan-Cousins Hive, complete with 11 standard frames, wired and fitted with ⅓ sheet best comb foundation, division board; 21 section super with full sheets thin foundation and zinc dividers, calico and felt quilts	28	0	0
2.	The Cowan-Cousins Hive, complete, painted white zinc, 3 coats	30	0	0
3.	Smoker	3	0	0
4.	Smoker cartridges, per dozen... ...	0	12	0
5.	Veil for protecting face	1	0	0
6.	Gloves with gauntlets attached ...	1	8	0
7.	Feeder, bottle and stage	2	4	0
8.	Sections, made of white American bass wood, per 100	4	0	0
9.	English made "Weed" brood comb foundation, standard size (8 sheets to the lb.) per lb.	3	0	0
10.	Thin super foundation for sections per lb ...	4	0	0
11.	Spur embedder for fastening foundation firmly to wires...	1	0	0
*12.	Honey extractor, with chain gear ...	35	0	0
13.	Wax extractor, solar, glass top ...	7	8	0
14.	Bee escapes, Porter's patent	0	10	0
15.	Queen cages, pipe cover pattern ...	0	8	0
16.	Metal dividers, 4 bee-way, for use with sections, per doz.	1	0	0
17.	Super clearer, complete with Porter bee escape	2	8	0
18.	Brass cones for ventilating hives, each ...	0	2	0
19.	Spirit levels for levelling hives ...	1	8	0
20.	Quilting, thick felt, cut to fit brood chamber, per piece	0	8	0
21.	Wire for wiring frames in reels per reel 12 annas and Re. 1-8-0—(the larger reel will suffice for some 100 frames).			
22.	Prideaux fasteners, useful for fastening Solar Wax Extractor Lids, &c., each ...	0	3	0

*Honey extractors not at present in stock, but can be supplied to order.

		Rs.	A.	P.
23.	Ant Proof cast iron Hive Leg Shoes, set of 4	1	12	0
24.	Comb carrier for wall hive, to take 11 standard frames, as recommended by Agricultural Research Institute, Pusa ...	1	8	0
25.	Standard frames, plain, per doz. ...	2	0	0
26.	Ditto wired	3	0	0
26.	Ditto wired and fitted with $\frac{1}{3}$ sheet comb foundation ready for use, per doz.	5	4	0

N.B.—A suitable outfit to ensure a successful start in Bee-Keeping on modern lines, consisting of items 1, 3, 5, 6, 7 of above list will be furnished for Rs. 33.

Prices subject to fluctuation of the market.